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THE AMERICAN GAS LIGHT JOURNAL

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BRIEFLY TOLD.

THE EDUCATIONAL WORK OF THE AMERICAN GAS LIGHT ASSOCIATION.—Last week we had occasion to make short mention of a proposition, that emanated from the Committee on Educational Work of the American Gas Light Association, which proposition involved an important method of bettering, or continuing, the work in which the Committee is engaged. When the Committee was originally appointed, we, in common with many, did not believe that its accomplishings would amount to much, our beliefs being founded on the thought, generated from experience, that, though many committees had been chosen, few felt called upon to perform the work allotted. In this instance we are well satisfied to acknowledge our underestimate, for the Educational Committee of the American Gas Light Association has performed its work in a manner well calculated to gain the unqualified approval of everyone connected with the American industry. Scores of young (and old) men have been benefitted by the simple, common-sense teachings of the Committee, since it undertook its educational work, perhaps three years ago; and that its undertakings and accomplishings have not been made of greater public account is no fault of ours. The Committee preferred evidently to carry on its work unobtrusively and quietly, and that its work has been so carried on cannot be successfully denied. The modesty of conception, however, is no longer a factor, for the growth of the child is that in which we seem to be and are concerned; and in that concerning we hope the appeal of the Educational Committee will be properly heeded. The Committee's call is not a demand, but is rather the implied expression of a belief that those engaged in the gas industry of America are sufficiently self-reliant to cheerfully subscribe to a fund, to be controlled by themselves, that will enable them to found a training school for gas engineering, which division of American industry (ranking it in earning power in respect of returns in the shape of capital invested and dividends returned) is just fourth on the list—and in this order: Banking, street railroading, water supplying, gas supplying. The main educational centers and homes of our country have been quite remiss in the matter of founding "chairs" for the dispensing of knowledge regarding water and gas supply, although many of them have chairs for the diffusion of electrical knowledge, so it will be all the more satisfactory if the gas men themselves are the originators of the first "home" for the teaching of the principles of their profession and trade. In this belief and view we heartily urge a thorough and quiet study of the circular presented by the American Association's Committee on Educational Work, as that circular appears in our current issue. The circular is so plain in its terms that no word of explanation of ours can make it clearer, and we hope and believe that its appeal will be heeded. Sums of subscription may be made in any amount, from $1 and upwards; and it is our satisfaction to subscribe, on behalf of the AMERICAN GAS LIGHT JOURNAL, the annual payment of $25, for the named period in the circular, or for such other and longer period as the Committee may deem necessary for the successful prosecution of its educational work. We earnestly ask our readers to consider the proposition advanced by the Committee, and advise them to name at once to the Committee the sums they are willing to subscribe. The magnitude and value of the

plan proposed to the gas industry of America by the Committee cannot be over-estimated.

"The Calcium Carbide Industry."—Under this caption, *Engineering* (and no better printed authority on engineering questions is today published in the world), dated July 15 last, reviews the "progress in the calcium carbide industry" since its prior review of the same subject, which appeared in its columns, October 29 last. The review, of course, is general in scope, and we hope that its findings, in respect of the growth of the carbide industry in other countries, are more accurate than is its references to such growth in the United States. Respecting the latter, *Engineering* says: "Professor Thompson has stated that in the United States nearly every gas works possesses, or is erecting, a carbide plant, in order to use acetylene gas as an enricher for the coal or oil gas ordinarily produced." The plain fact of the matter is that not a gas works in the United States is using acetylene as an enricher "for the coal or oil gas" that is being daily "produced."

Notes.—The Nathaniel Tufts Meter Company has secured commodious and well arranged shops at No. 8 Medford street, Boston. The new plant is up to every demand that may or can be made upon it, and it may be depended upon that "H. A. N." will see to it that all orders "coming his way" will be promptly honored. The Company is to construct three 16-ft. meters for the projectors of the Massachusetts Pipe Line Company, and has completed or is about completing a 10-ft. meter for the Portland (Me.) Company.——At the annual meeting of the Cambridge (Md.) Gas Company the following Directors were elected: W. J. Hopkins, Geo. W. Woolford, John R. Pattison, Jas. C. Leonard, Jas. Wallace, D. H. Le Compte, S. Lehman, A. J. Dunn and Jno. G. Mills.——The United Gas Improvement Company is to build the generating plant for the Mount Clemens (Mich.) Gas Company. The installation is to be a standard, double superheater Lowe water gas apparatus up to a daily capacity of 125,000 cubic feet.

Correspondence

[The Journal is not responsible for the opinions expressed by correspondents.]

A Reply to "Manager's" Inquiry.

Buffalo, N. Y., July 26th, 1898.

To the Editors American Gas Light Journal:

Having read "Manager's" inquiry, as printed in the Journal for July 11th, for knowledge respecting how to cure a leaking cup in a gasholder, I may be forgiven, at the outset, for suggesting that his description of the trouble and its cause is rather meager. In a rough way, and as intimating that the prescription equals the description, let me offer the advice that, providing the leak is not too wide, if "Manager" will shake and stir in a quantity of wheat bran, just as the holder's section is lifting, he will find, if the fissures or rents are not too long or wide, that the bran will be drawn in by the passing out of the water, thus closing the rents. Of course, if the holder has outlived its usefulness, whether in tank, section or cup—not to say a word about its framing, guide rails or balance—the only recourse to "Manager" would be to have his company purchase a new retaining vessel.

Respectfully yours, W. K.

Testing the Permeability of Paints.

The *Journal of Gas Lighting* "notes" that a quick method of testing the permeability of paint by water and gases is proposed by H. Loesner. Small strips of sheet iron, of uniform size, are carefully brightened on one side by rubbing with emery or glass paper and immediately coated with a thin layer of the paint under examination. Four days later another coating is applied, and the slips are allowed to dry for four days longer. They are then laid, paint downwards, over a constant level water bath, being supported at a height of 50 mm. above the surface of the boiling water. After 15 hours' exposure to the ascending steam, the paint is dried at a maximum temperature of 100 C. It is then removed by the aid of aniline and a soft brush, when the surface of the metal should be found free from rust, if the paint is good.

The effect of acid vapors may be tested in the same way, except that concentrated (33 per cent.) hydrochloric acid is substituted for the water, and the protective incrustation formed on the surface of the paint is to be rinsed off every hour, the temperature being 20° C., and the time of exposure 12 hours. A good idea of the comparative protecting value of paints and other rust-preventing applications for iron-work may be obtained in this way. Substances sold by the same name are found to differ widely in this quality. Good paint should stand the treatment for a minimum of 12 hours.

The Proposed Fund to Carry on the Educational Work of the American Gas Light Association.

Last week it was editorially noted that the Committee in charge of the educational work of the American Gas Light Association had decided to call upon the fraternity at large for subscriptions to a fund so that the task so well carried out (since the work was commenced in 1895) might be continued. The circular issued by the Committee tersely and satisfactorily explains why the action proposed in it is deemed necessary, and it is hoped and believed that the sum asked for ($3,000 per annum for 5 years) will be subscribed with the necessary guarantee before the current year is at an end. The text of the circular is appended:

"*Brief Statement in Relation to the Educational Work of the American Gas Light Association, and Collateral Matters.*—There are among gas company employees many uneducated or partially educated men, occupying, or striving to fit themselves to occupy, minor positions of responsibility. From them will come many of the foremen and superintendents of gas works of the next 25 years. It is of importance to the industry that they be aided and directed in their efforts to obtain a substitute for the schooling that they have missed.

"Some three years ago certain members of the American Gas Light Association conceived the plan of helping these men to obtain a better education in gas engineering. The majority of the Association felt that this most important work could not be properly executed by the Association, on account of the lack of funds to engage the services of some man both scientifically educated and practically qualified as a gas engineer. Those having the matter most closely at heart finally obtained the official endorsement of the Association, with the understanding that the Committee to be made up from these men would see that the work was properly prosecuted without expense to the Association.

"The Committee was formed and the work begun in 1895. The results so far obtained have been far more favorable than even the warmest advocates of the scheme had dared to hope for. But this was rendered possible only by the fact that one man in particular was willing and able to take the major part of the burden on his shoulders.

"This man, Mr. Walton Clark, now finds it impossible to longer carry the burden, and the question now has to be faced; shall we allow this admirable work, so well and thoroughly begun, to be abandoned?

"In considering the question, we not only have to think of the good that may yet be done to those who have not joined in the movement, but we have to meet the present evil in the case of the members of the existing classes, now numbering 60, who will be unable to longer avail themselves of this most practical assistance toward a more useful career.

"There are many spontaneous applications now in hand for membership in the next class, which applications cannot be acted upon favorably unless this appeal meets with success.

"The undersigned, a Committee appointed by the Council of the American Association to consider this and allied subjects, believe that they are now able to suggest a plan which will provide for the prosecution of this work and also make the Association of far greater value than heretofore to its membership and to the gas companies in general.

"In brief, the idea is to obtain subscriptions from gas companies and individuals to an educational fund, which shall amount in the aggregate to not less than $3,000 per annum, and that these pledges shall be for not less than five years, so as to ensure the permanency of the work; for it is believed that if successfully prosecuted for five years the future of the scheme can be looked forward to with confidence.

"This fund would be pledged, not to the Association, but to a Board of Trustees, first appointed by the Association, and thus by it sanctioned and endorsed. Two members to be the President and Junior Past President, and the other three to be appointed upon the recommendation of the Council; the Trustees then to have the right to fill vacancies. It is believed that by thus having in the hands of those specially interested in the scheme the selection of the man to have charge of the prosecution of the work, a thoroughly competent man can be obtained; and if the Association elects as its Secretary one fitted for both offices, the two can be for the time practically combined, thus making each position more attractive to men of the necessary ability.

"The Committee have reason for saying that, if the proper financial arrangements can be made, they will be able to secure for this work a man entirely competent for it, and one who would certainly be approved by the members of the Association and the men interested in the gas industry generally.

"It would be the expectation, in connection with this probable consolidation of duties, to establish a permanent headquarters for the

American Association, where a reference library could be collected, and where special effort would be made to keep on hand all data as to the engineering, legal, commercial and municipal branches of the business, thus giving the members of the Association and the subscribers to this fund the opportunity to quickly investigate any special matter under consideration.

"We trust you will be sufficiently impressed with the merit of this scheme thus briefly and imperfectly outlined to give us your practical support.

We shall be glad to furnish more detailed information in all cases where desired. Respectfully,

ALEX. C. HUMPHREYS, 31 Nassau street, New York.
CHAS. H. NETTLETON, Derby, Conn.
GEO. G. RAMSDELL, 222 S. Third street, Phila., Pa.
} Committee.

The form of subscription accompanying the circular is as follows:

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.....hereby pledges the annual payment for five consecutive years of.....dollars towards the educational work inaugurated under the auspices of the American Gas Light Association, payments to be made on the 1st of November of this year, and on October 1st each year thereafter, and to be paid to the Trustees of the fund, yet to be appointed.

NOTE.—This subscription to be returned to any of the Committee. Subscribers will later be notified of the appointment of a Treasurer.

[Prepared for the JOURNAL.]

Note on Further Studies into the Phenomena of Gas Explosions.

By DR. W. H. BIRCHMORE.

Last year I published in the JOURNAL a resume[1] of the experiments I had up to that time made in relation to gas explosions produced under such conditions of control that the results could be carefully observed. In this article I drew attention to the direction of propagation as distinguished from other phenomena, but incidentally mentioned the apparent antithesis between the wrecking and incendiary power of an explosion.

This series of facts has been carefully reinvestigated during the current year, and I believe myself justified in asserting that the antithesis exists. The extent and limitations I do not yet know, except in the most general way. It is my intention in this article to describe certain experiments, made with a view towards the question just stated, and at the same time to mention certain results which appeared, unsought for and quite unexpectedly.

Before entering upon such description certain facts must be premised. All explosions were made over mercury, and so likewise all measurements. The measuring apparatus was supplied with apparatus for controlling the temperature; and ascertaining it, as well as the pressure. By this means the temperature of the gas under examination was not a matter of conjecture, but of knowledge.

The standard for volume was arbitrary, but the upper edge of the mercury could be brought to coincide with certainty within one-tenth millimeter of the same plate for each series of measurements, and practically within one-fiftieth. As this error represented in cubic value less than one-tenth-millionth of the standard volume such error was regarded as non-existent.

The height of the manometer was read by telescope to one one-hundreth millimeter.

An apparatus was also arranged so that a glass balloon filled with gas could be weighed under known conditions of temperature and pressure. At first sight the use of such precaution seems like an affectation of accuracy, but it becomes quite evident after a little consideration that, if two volumes of gas, exactly equal or equal within one-tenth millionth part at a given temperature and pressure, weigh differently, the gases cannot be identical in composition. The limit of accuracy in the measure of the standard volume has been given, the variant left is that of temperature. Do my best, I have been unable to obtain thermometric measures of an accuracy equal to those of weight and volume. Still the error thus introduced is easily detected and may with care usually be allowed for. Consequently the only mistake not provided against was the confusion between hydrocarbon gases and hydrocarbon vapors.

1. See JOURNAL, Oct. 11, 1897, p. 563.

My first experiments were made on a mixture of hydrogen and oxygen, as nearly pure and dry as I was able to obtain, intending to test the apparatus and to verify the Bunsen data. I do not care to publish my results just yet, but I can assure all interested that these data need most careful revision. They can not be safely used as "correction constants," as they need a correction themselves.

As stated, the chief object of this series of observations was to ascertain, if possible, why the force of the explosion of seemingly identical mixtures of gases should be so much greater in some cases than in others, and why the incendiary effects should so very greatly vary also.

These experiments were made on very diverse mixtures. Sometimes oxygen was used, sometimes common air as the sustainer of combustion, the fuel being sometimes pure hydrogen, sometimes marsh gas, while carbon monoxide and acetylene were experimented with not infrequently, and sometimes the vapor of complex hydrocarbons was introduced.

As I have previously stated, consecutive explosions may be obtained from mixtures of gasoline and air, and sometimes, but less frequently, from the vapors from flames.

It may be within the memory of some of the readers of the JOURNAL that during the winter an explosion of illuminating gas occurred in a town not far from this city, which presented the following peculiarities: Gas had escaped in considerable quantity, seemingly from an open fixture, from the falling off of a rubber tube, in a room adjacent to the one in which the explosion occurred, or rather began, and the explosion was started by the occupant of the flat striking a match in the outer room. In this room the windows were literally pulverized. The glass was blown to atoms, but so trifling was the incendiary effect that a package of absorbent cotton on the table was hardly singed, and was found, after the excitement had subsided, almost intact. It had not been set on fire, while in the adjacent room the window shades were set on fire, as were also some newspapers and a basket of waste paper. The woodwork was also fire marked and the furniture cushions scorched, but the windows were not blown out, nor was the gas ignited at the fixture, but continued to escape until turned off some 10 minutes or so after the explosion. The rooms were steam heated, and in the front room, in which the mixture of gas and air was ignited, was a fireplace, with gas log, not lighted, which gave ventilation.

The peculiar condition presented attracted my attention, and I set to work to reproduce the conditions. This I did in the following way: Judging that the gas had largely displaced the air in the room in which it escaped, and, as the door of communication between the two rooms was replaced by a heavy curtain, that the diffusion had been slow, I arranged my apparatus thus. Two receivers of a quart capacity were connected by a piece of glass tube, ¼ inch bore and 8 inches long. The first I connected with the gas jet by a rubber tube with a water seal in its length, and in it I placed a piece of tissue paper, connected it with the second, in which I placed some absorbent cotton, and, to represent the chimney, inserted a piece of thermometer tube to allow the gas to diffuse. Platinum sparking points represented the match. The connections were all made as firm as possible, so that if explosion occurred it should not blow them out; the whole was placed under a wire gauze cage, the coil started and the gas turned on. In a few minutes a smart explosion followed. In the balloon containing the absorbent cotton and the sparking points there was a flash of bright violet light and the glass was broken—the gas could be seen to burn back through the connecting tube with a luminous flame; the explosion in the second balloon followed and it was also luminous; the luminous flame in the tube was red, in the second balloon white. The absorbent cotton was not singed, and the paper was set on fire, but the second balloon was not broken, probably because the force of the explosion was expended in driving gases of combustion out of the ¼-inch communication tube.

I had, then, within certain limits, produced experimentally the more important phenomena of the accident alluded to. It remained, if possible, to ascertain the differences in the mixtures producing such divergent results.

In my previous paper I mentioned the occurrence of luminous flame explosions as a not infrequent phenomenon when the amount of air in the explosion pipette is insufficient for perfect combustion, and I at once assumed that this was the explanation here, and that in the reduction of volume with consequent influx of air was to be found the cause of the continued combustion. This is the obvious explanation, and I think it would at first sight be the one given by everyone at all familiar with gas explosion phenomena, although there are decided objections to it.

I next tried, by introducing measured amounts of gas and air, to find the limit at which luminous explosion—that is, explosion accom-

panied by luminous flame—gives place to non-luminous, or rather violet flame explosion.

Just here, however, comes in the question of why a violet flame. The spectroscope contradicts the evidence of the unaided eye, and asserts that the flame is green as well as violet; indeed, it makes almost a flat contradiction, for the violet light in the flame is vastly less than the green, when examined in this way.

On referring to literature, one finds certain statements about gas explosions which are peculiar. Hempel cautions that the combustible gas must not exceed the theoretical proportion, or the result will be vitiated, and experience teaches that if the combustible gas is insufficient it will not ignite; and we are cautioned on all sides to cushion the explosion with some inert gas, nitrogen preferred.

It was while trying to assure myself of these proportions (the exact amounts of illuminating gas and air) that I came across the results which I now wish to lay before the readers of the JOURNAL, and thus put on record. I have said enough in regard to the apparatus employed to show its delicacy and exactitude, and to justify myself in insisting on my conclusions.

Where hydrogen and air are exploded the result is never theoretically correct, if the amount of hydrogen is measured first and the residual oxygen measured immediately after the explosion by the phosphorus absorption, or pyrogallate methods. The error is large, often amounting to 7 or 8 parts per 1,000. If one allows a considerable period to elapse (say 3 or 4 hours), the error may reduce to 2 or 1½ per 1,000, but the error is there. To state the difficulty more explicitly. If one uses assayed air, known to contain 20.94 per cent. of oxygen, using all precaution, a certain amount of oxygen seems to disappear, to reappear again after a definite period, some of it never reappearing. Are we then justified in thinking some hydrogen peroxide is formed in the explosion which remains dissolved in the water formed? I certainly think so. If we introduce a very small quantity of ammonia, so small a quantity as three parts per thousand, we can so vitiate the result as to make it worthless as a measure of the hydrogen, and presumably a relative error is introduced when the ammonia is only a fraction of a part per thousand.

In a complicated mixture of gases, ammonia, if not present, may be formed in the process of the explosion. This is easily demonstrated by exploding acetylene with assayed air, in which case both cyanogen and ammonia are produced, even in the presence of excess of oxygen; and, strange to say, oxides of nitrogen also result. What does this signify? Are we to assume that when acetylene is burned in free air the like result is produced? It certainly seems plausible enough. Surely common methods must be improved if we have yet to reckon with such changes as these.

Exploding the mixture of hydrogen, acetylene, and assayed air gives margins of error amounting in some instances to more than 12 parts per 1,000, from just these mentioned causes; the formation of nitrogen containing molecules.

When mixtures of hydrogen, carbon monoxide, acetylene and assayed air are exploded over water containing traces of methyl-orange the spectroscope shows, by the change in the position of the absorption band, that sometimes an alkaline reaction, sometimes a very acid one, results. Here again we must admit the production of a nitrogen acid, hydroxide, with or without the presence of carbon in the molecule.

The question of importance to the public health raised by these experiments then is this: May not acetylene, when burned from a burner as well as when exploded, produce substances as dangerous to human health as hydrogen cyanide or cyanate and oxides of nitrogen? It would seem to justify much expenditure of time and trouble and some money to find out just what happens in this case.

A mixture of hydrogen, carbon monoxide and the petroleum vapor obtained by distilling gasoline at a reduced pressure and then passing the vapor through red hot, air-free iron tubes was next experimented with.

In this case the results were more nearly in accord with theory, and the difference between the results obtained from these gases and acetylene was very marked.

By proportioning the charge in a certain way, not likely to occur in practice, carbon-nitrogen compounds were to be obtained, and, with precaution, oxides of nitrogen; but the inference is sufficiently obvious.

While with the gas mixtures containing acetylene the cyanides and the oxides of nitrogen were produced invariably, with the acetylene free gases they were produced only under special conditions.

The question of the method of formation is not without interest. How are these peculiar compounds obtained?

Setting one side as not germane at this present the purely chemical discussion, the mechanical side can be presented.

We know only too well that when superheated (that is, unstable) carbon molecules are in intimate mechanical contact with white hot air, since the nitrogen is greatly in excess of the oxygen and quite as ready to unite, the chances are about four to one that the carbon-nitrogen molecule, cyanogen, will form rather than the carbon-oxygen one. It is equally evident that, the amount of hydrogen being less in proportion, the flame will be of proportionately higher temperature, and that the cyanogen may in consequence burn; but if so, it must burn in an atmosphere outside the primary flame, surrounding, or rather topping off, the flame with a bluish corona in which nitrogen oxides are the secondary product. Herein is the explanation of the formation of the destructive elements; the nitrogen oxides now known to form in very hot flames—*e. g.*, that of acetylene.

[Communicated Article.]

A Suggestion to "Manager" in the Matter of a Leaking Cup in a Gasholder.

By MR. J. P. GILL.

I notice in the JOURNAL of July 11th a request from "Manager," in reference to a leak in the upper cup of a 115 foot holder. The writer has had no experience of that description, but has had occasion to stop similar small leaks under water.

It appears that the leak is a small one at the angle iron at the bottom of the vertical plate forming the hydraulic cup. It is suggested that the circumference of the holder be divided into sections, each one equal to the length of a bottom plate and treated successively. Just before the cup reaches the water in the tank let there be emptied into it a quantity of oatmeal (not ground too fine) for the length of the aforesaid section and sufficient to cover the bottom of the cup to a depth of 2 inches or so. This will, of course, be between the dip plate at the top of the next lower section of holder and the bottom of the upper section. As soon as the upper section begins to descend below the top of the other, making a space between the dip and the bottom of the cup, the oatmeal should be stirred and worked, so as to pass it outside of the dip in order to reach a point where the leak may be. The holder should not descend so fast as to allow the tank water to enter the cup too quickly. If the oatmeal should then reach the leak it will be drawn in by the suction of the outgoing water and choke it off. This would have to be done at night, when the upper section had descended to the required level and before it began to rise again with the incoming gas.

The supposition is that the leak is known by the lowering of the water in the cup. Now if it is found, after proceeding as above, that the water in the cup does not lower, nothing further will be required. If however, the leak is not stopped, another section must be treated in like manner. Successive sections have been recommended for the purpose of avoiding the trouble of going round the entire holder, if the leak should be found sooner. Perhaps the better method would be to go round the holder at once instead of by sections, putting in sufficient oatmeal on the plan previously mentioned. The oatmeal could then be agitated several times on successive occasions.

When the leak is stopped most of the oatmeal can be pumped out, replacing the water that may be wasted. It appears that this method of finding and stopping the leak will be speedier, less expensive and more effective than by boring holes in order to get into the interior of the cup.

Tar in Road Making.

The *Gas World* reports that at the annual meeting of the Association of Municipal and County Engineers, held in Edinburgh, early last month, Mr. A. H. Campbell, City Surveyor, Canterbury, read a paper on the use of tarred macadam in the construction of roadways. As this method of constructing roadways promises a growing outlet for the tar production of gas works, a few extracts from Mr. Campbell's paper will not be out of place:

There is no improved form of macadam which is so coming to the front, and demanding that attention which its merits unquestionably deserve, as that now going by the name of tarred macadam; that is, a combination of any of the stones, gravel, or clinkers commonly used in the making of macadam roads with a mixture of tar. It appears a simple enough composition, but its preparation and laying, so as to turn out a success, bristle with delicate detail. When properly made, and on roads suited for it, this construction of road is smooth and noise-

less, it is non-absorbent, it is cleanly in itself and easily kept clean, and its first cost is within the capacity of the most reasonably restricted finance of small towns and districts. With all the advantages enumerated, it appears remarkable that tarred macadam has not been adopted except, as yet, on the most limited scale. It is true that tarred gravel or limestone footpaths have been in use for a great number of years, and have now obtained a deservedly wide adoption, but the extension of this same composition, only of a larger gauge metal, to the construction of roadways has been most limited. As accounting for this, these reasons may be suggested, viz., the failures which frequently attend a first trial, and uncertainty as to the properties and action of tar and as to how it will unite with the aggregate which it is designed to incorporate. The author can speak from personal experience of its failure and of its success too—failure where success was expected, and success where failure might be anticipated. This as evidence of the fickle character of the composition.

Firing the Stone.—As regards the nature or description of the aggregate, the author has tried Kentish ragstone, surface picked flints, pit gravel, and Guernsey granite. The stone is prepared for the tar by burning in the open. It is laid out first of all in a flat bed about 12 inches thick, and of rectangular plan. On this is spread a layer of coke and breeze about 3 inches to 4 inches thick, with a little wood to assist the fire. This is then overlaid so as to form a stack of stone of about 5 feet in height from the ground. Meantime, as the last addition of height is made, the fire of wood and coke has been kindled, and the fire is allowed to penetrate the stack. About 1½ chaldrons (54 bushels) of coke are consumed in a stack of 60 cube yards. This operation may take any time between seven and ten days. The stack is then opened up, and the hot stone applied to the prepared tar. In firing the stone a great deal of loss by disintegration occurs, the stone succumbing to the influence of fire, and tending to get reduced to a coarse-grained powder. Particularly so was this the case with a trial of granite exposed to fire, which quickly produced the condition above described. For this reason the author would much prefer the heating of the stone in an oven or kiln; the temperature would be more equable, and the severe firing, causing the disintegration described, would be avoided.

On the subject of heating one or two remarks may be submitted The author believes it to be the practice with some makers not to heat the stone at all, but, being sure that the stone is dry and free from moisture, apply it in the cold but thoroughly dry state to the prepared tar. This condition of the stone, in the author's opinion, resembles the risk attached to laying the tarred mixture in position in cold instead of hot weather. The tar refuses to work, the temperatures are so unequal, and when the sun (particularly the sun of the sunny south) beats upon such a road it is not improbable that this defect will discover itself in the liquefied tar bubbling and spewing itself up over the surface. The proper or, at least, the best condition of heating is to be obtained by the kiln, where the heat will be rather of the moderate baking than of the hot roasting sort. The temperature of the stone when the tar is applied should be such as the palm of the hand can bear with comfort; if too hot, the tar will be destroyed as a cohesive; if too cold, the tar will go on too thickly, and under the rays of a hot sun will soften.

Grading.—The hot stone, when ready to be mixed with the prepared tar, is sifted through two gauges, graduated to 1 inch and to ½ inch, giving three sizes of material—viz., 1-inch to 2-inch gauge for the body material, ½-inch to 1-inch gauge for the intermediate or fining coat, and ¼-inch to ½-inch gauge for the skin or top dressing. These three sizes are laid in layers as follows—viz., 3 inches to 4 inches thick of the coarse, about ½ inch thick of the intermediate, and the top dressing in the thinnest layer possible, with a view only to filling all interstices. Thereafter a dressing of fine ¼ inch granite or limestone siftings is scattered broadcast, and the traffic at once allowed on the road, working this top dressing in, and assisting in the consolidation of the road formation. The weight of the roller employed by the author is nominally 10 tons, and each of the three layers is rolled separately. Considerable importance is attached to the state of the weather at the time of laying, in the sun by preference, and to assure a good result; if laid in a cold temperature, and with any defects present in the composition, disappointment and possible failure will result. Weather being normal, any time between May and September (inclusive) may be regarded as suitable. One word as to wet weather; operations both of mixing and of laying should be suspended in time of "wet," where conducted in the open, as nothing so corrupts the composition as the presence of moisture.

In constructing a road of this tarred composition, the old surface is removed to a depth of 8 inches, and re-made with a 4-inch thickness of dry, hard, broken stone, furnace clinker or brick. This is rolled smooth and finished to the desired camber of the road. The author's reasons for this underlying ballasting of dry material are twofold: (1) to separate the tarred composition from any damp substratum, and (2) to economize in the thickness of tarred material. Under the author's practice the tarred composition is only 4 inches thick (finished). This, by itself, would be an insufficient surface formation to bear the traffic and resist the damp, but underlaid by the dry ballasting of hard material, well rolled and preferably grouted with cement or brushed with well boiled tar, it appears to answer the requirements for which it is introduced.

One sentence is necessary as to having the tarred mixture all in a fresh or "live" state when being laid, otherwise cracking and disintegration of the road will rapidly occur; also in keeping off all traffic during the progress of the work, not because the traffic in itself is an injury, but because of the dirt, dust and other matter foreign to the mixture being imported, and destroying the binding together of the layers in one corporate mass.

Quality of Tar.—The quality of the tar employed is no less important than the other details of the work. Some trading firms making this material use the refined or distilled tar, and excellent results are thus obtainable; but more commonly it is the ordinary gas tar that is used, at a cost of about 2d. per gallon. This tar should be, as far as possible, free from water, of a stiff, dense consistency, any defects of this character having to be counteracted in the boiling operation. The lighter the tar the longer it must boil, so that all light oils are driven off. The following pertinent observations on the subject of coal tar have been submitted by the author's friend and colleague (Mr. Sidney Harvey, F.I.C., public analyst): "Coal tar is a by-product of extremely complex constitution, containing matters volatile at various temperatures. The effect of heat upon coal tar would be to volatilize certain principles therein, whereby the residue would be more viscid and tenacious than the original substance, while its melting or softening point will be proportionately raised. As the ultimate result of the continuous application of heat is coal tar pitch, it is desirable, when coal tar is used in conjunction with road making materials, that the heat in question should be applied long enough to secure the most tenacious and difficultly fusible product, but not pushed so far as to bring about a brittle nature to the pitch itself, which latter would defeat the effect aimed at, which is to agglutinate the fragments of rock material with a water tight cement, which, while protecting the mineral from weathering, would not yield to the heating action of the sun's rays." In the author's practice the tar is boiled in 50-gallon coppers. It is brought to the boil and maintained so for a period varying from three to four hours; with good conditioned tar three hours boiling is amply sufficient. To each 50 gallons of tar is added a small proportion of pitch (about half a bucketful), and these are boiled together. The author would not assert the necessity of introducing even this small proportion of pitch; but the cost is almost infinitesimal, and as a counteractive to bad quality of tar it is good and worth introducing.

Quantities and Costs.—The quantity of tar employed appears to vary with different makers, just as much as do the other details of this interesting work. It also varies with the season and with the consideration whether, when mixed, the material is to be laid at once or stored up in a heap. If the weather is cold, and if the material is to be stored, the less should be the quantity of tar used. Weather being hot and material being laid down at once, a slightly greater proportion of tar may be used than under the reverse conditions. At the present season, with the material being laid soon after mixing, although a brief storage is found necessary, the following are the quantities of tar that are used:

	Gallons per Cubic Yard.
With the coarse (1 inch to 2-inch gauge) material..	8
With intermediate (½-inch to 1-inch gauge) material	10
With fine sifted stone (¼ inch gauge) material.....	12

From a return supplied to me by the foreman of works, the author submits the following statement giving the detail cost of the material. The stack of stone operated on for test contained 45 cubic yards, and the actual cost in preparing that quantity is:

Debit.

45 cubic yards pit gravel at 3s. 6d.....	£7	17	6
79 gallons tar and cartage at 2½d. per gallon	0	16	5½
234 pounds of pitch at 46s. 8d. per ton.....	0	4	10½
84 bushels of coke* at 9s. 4d. per chaldron.	1	1	9½
30 bushels of breeze.....	0	8	0
Wages in preparing and mixing stone and tar	7	18	7
	£18	7	2½

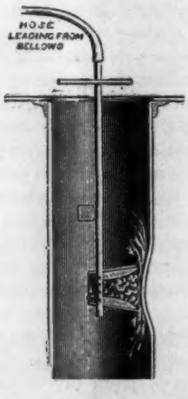
* Includes the coke consumed in the tar boiler.

Credit.—Actual product from the foregoing, 40 cubic yards of mixture costing £18 7s. 2½d., equal to 9s. 2d. per cubic yard.

The life of this description of road may be taken at seven years; the annual cost will work out at 7.7d. During this term it may become necessary to outlay certain small amounts in repairs, so as to maintain the surface smooth, whole, and impervious; this, estimated at 2d. per yard per annum, will give a grand total of 9.7d. per super yard per annum. This rate for a good street pavement in urban districts, for heavy vehicular traffic of the ordinary sort—that is, excluding traction engine traffic, for which it is unsuited—is most moderate. Even with the ordinary macadam it is rather less; and side by side with any of the improved harder pavements, wood, compressed asphalt, or sets on concrete beds, it is incomparably less costly.

Setting Back Bulges in Furnaces.

A "Boiler Inspector," writing in *Engineering* (London) says: The usual method of setting back bulges in furnaces is to apply a fire below, and then to force the fire by a blast led from a rivet fire bellows. After the bulge has been sufficiently heated the fire is withdrawn, and a jack applied to force back the bulges. This must be quickly done, or else the bulge will have cooled down so much that it cannot be forced back. In the limited room for working, it is always an awkward and unpleasant job. In removing the fire it often gets spilled about, and the necessary packing to keep it up to the bulge has also to be cleared out



of the furnace, and during the time this is being done the heated part is rapidly cooling. For reheating the fire has again to be packed up against the bulge, and the cycle of operations repeated till the furnace is sufficiently restored to shape. The whole of the work has invariably to be performed at the place where the boiler is worked, with what appliances can be most conveniently found, often by workmen who have had no experience with this class of work.

The writer designed the method shown on annexed sketch to get over some of the difficulties connected with this job, and he believes it is an improvement on the usual methods. The whole of the materials required can generally be got, even in the most out of-the-way places, with little trouble.

A wrought-iron pipe, about 1 inch diameter, is fitted to the bottom of a wrought iron bucket, as shown. The end which passes a short distance through being plugged up, the upper part inside the bucket perforated by a slot or several holes, and the bucket lined with fireclay, a cross handle to steady the whole is clipped on near the other end of the pipe, that end being connected, preferably by a hose pipe, with the rivet fire bellows. The fire is kindled and got properly started before inserting in the furnace. A suitable crossbar with a notch in it is inserted in the furnace tube. The fire can be quickly placed in position under the bulge, and by grasping the cross handle and the end of the tube, can be quickly manipulated as required. It can be quickly withdrawn and laid down well back from the boiler front, so as to be out of the way, and the jack applied to the bulge with the minimum loss of time.

A 15 to 20-ton hydraulic jack is the best to use. A small piece of ½-inch or ¾-inch plate, heated to redness and bent to the circle of the furnace, should be put on the top of the jack to prevent it from cooling and marking the furnace plate. A larger plate, bent to the circle of the furnace, should be placed below the jack to distribute the stress. If any packing is required to bring the jack against the bulge, a single block of good hard wood of suitable thickness should be used. The bulge should be pressed back by the jack; at the same time a little judicious flogging on the water side will make it go back easier.

After the furnace has been restored as near as practicable to original shape, the parts that have been set back should be heated to a dull red to remove any local stresses that may have been set up in the plates. As the fire can be easily shifted about to any desired part of the furnace, this can be easily done.

Transformer Economy.

By Prof. Winder Elwell Goldsborough.

A great deal has been said and written about the static transformer of alternating currents, and yet we are only just beginning to understand this much discussed piece of apparatus. The manufacturers have made it and experimented with it, the theorists have experimented with it and disputed over it, the underwriters have disputed over it and endured it, and the central station men have endured it and made use of it to the great good and comfort of the public. No other piece of apparatus in the field of electrical engineering has been lauded higher or been the subject of greater abuse, and to all it has served a purpose.

To-day the transformer occupies a higher position than ever before, and it grows in importance as each new development in the field of applied electricity points out a new department of usefulness for it.

There has, however, been enough agitation lately on the part of manufacturers, in behalf of substituting new types of transformers for the old ones now in use, and of relegating the small transformer to the scrap heap, to cause the central station men, who are responsible for the successful operation of alternating current generating plants, some unrest. The foundations of many of these plants were laid before the time of skilled designers of electrical machinery, and at a period when the factory motto was "cut and try." As the public demands increased, the plants developed and expanded before the practical men were amenable to the "theories," and before the exact methods of the laboratory had become the daily practice of the constructing engineer. Managers see that engineers are still making mistakes, and that faulty design is still a factor in electrical development, and when they call to mind the enormous sums of money that have been spent in this country on ill-advised improvements it is not to be wondered at that they hesitate.

There is, however, a gradual change for the better in the number of the yearly contributions to the records of our electrical societies, and as these records are the expression of the best thoughts of the men who have made America famous as the land of electricity, they may be taken as signs of the times in our department of engineering activity.

We are constantly impressed with the fact that the refinements of exact scientific methods are being made the subject of everyday discussion, and that the more difficult problems of the technical side of the profession are being so well elucidated by our "practical theorists" that it is possible for all of us to enjoy a concrete appreciation of electrical science without an excessive expenditure of mental energy on the theoretical.

We are coming to a time when exact methods will be the universal rule and when the reputation of having a high "guessing factor" will no longer be a sufficient recommendation.

These influences are noticeable in the improved electrical intelligence of our workmen, as well as of our station engineers, and I find that it extends even to the general public. Indeed, a careful record of the number of times that I am asked "how does the little trolley wheel push the car along?" shows a yearly decrease of nearly 50 per cent.

So we see that matters adjudged to be of slight importance a few years ago are being allotted their normal position. A fault is a fault at the present day, and is not often disregarded as "too small to be appreciable." The old saying that "if you take care of the pennies, the dollars will take care of themselves" applies just as well to electrical engineering as it does to other professions, and it is the "pennies" that I am about to deal with.

Our principal mrnufacturing companies freely advertise and guarantee the specific economic performance of which each and every one of the transformers that they place upon the market is capable. They severally advertise to supply us with transformers equaling in efficiency, regulation (and what not) any other transformer that can be found upon the market.

The manufacturing companies are unanimous in their guarantees of high efficiency, low core losses, negligible aging and close regulation. If we can purchase transformers freely on these representations, with sufficient guarantee that the specifications advertised are strictly con-

formed to or improved upon, there is little to be desired on the part of the purchaser over and above what is offered. Any slight improvement that it shall be possible to make upon the best of the performances advertised by the competing factories will be forthcoming in consequence of the rivalries of trade, and the purchaser need only seek now for means of protecting himself against occasional faulty manufacture.

When, therefore, we consider the perfection to which this type of apparatus has been brought, in its every detail, and in sizes varying in capacity from a fraction of 1 to over 800 kilowatts, we have cause for congratulation.

If you have followed the design and manufacture of the commercial transformer, I think you will admit that at the present time the best of them are figured just about as close as is possible, and in fact we have almost reached the point beyond which any further advance in the direction of improved efficiency must be made by getting better insulating materials, requiring less space and giving this space to the iron and copper.

With a view to investigating the present status of the transformer and the ability of transformer manufacturers to meet in all cases the exacting specifications which they have laid down for themselves, I have had a number of transformers of recent design tested in the Purdue laboratories within the last year. The results of these tests are especially gratifying when gauged from the standpoint of our present commercial requirements, and to the specialist a detailed statement of the results would be interesting. In view of the fact, however, that the electrical literature of the day contains numerous matters of this kind I will not bore you with many figures, but rather discuss the results in a general way.

With but one exception the transformers tested have surpassed the requirements of the specifications laid down by Prof. Jackson in his excellent article on transformer testing, with which we are all familiar, and generally speaking they have conformed fairly close to the published guarantees of the companies submitting the transformers for test. To what extent this is true may be better appreciated if I cite one or two examples.

A 2.5 kilowatt transformer was submitted for test that was guaranteed to conform to or improve upon the following specifications: Core loss, 48 watts; regulation, 2.1 per cent.; and full load efficiency, 96.1 per cent. The test of this transformer gave: Core loss, 42.19 watts; regulation, 1.9 per cent.; full load efficiency, 96.2 per cent.

The showing made by this transformer is good. The core loss is 5.81 watts less than the stipulated value, and the efficiencies are in excess of the stipulated values. In this case the manufacturers more than substantiated their guarantee, and supplied a transformer that is a greater revenue producer than the specifications call for. If the core iron of this transformer can be relied upon as not materially increasing in its hysteretic loss with age, it is an easy matter to figure the money value of the excess economy that the transformer develops.

Suppose, for instance, a contract should be made for 40 of these transformers at $30 each to meet an increase in a station load of 100 kilowatts. On an all-day schedule these transformers would probably carry a commercial load equivalent to full load working for 5 hours. This assumption may seem to represent a better condition of service than is usually met with in practice, but it is an assumption that is fair to the manufacturer in considering the all-day efficiency. The transformers would therefore be working under no load for 6,935 hours and under full load for 1,825 hours per year, and under the conditions of the test would save 1,794 kilowatt hours to the station. If we figure the cost of producing this power at 2 cents per kilowatt hour, the saving per year would be $35.88 for the 40 transformers, or practically 3 per cent. on the amount invested in the transformers. If this power were sold for 6 cents per kilowatt hour it would represent a net gain to the purchaser of $1,794 \times .06 = \$107.64$ per year more than he had any right to expect under the contract specifications.

Another 2.5 kilowatt transformer submitted for test is advertised by the makers to show a core loss of 57 watts, a quarter load efficiency of 91 per cent., a full load efficiency of 96 per cent., a regulation of 2 per cent., and a no load current of .1 ampere. Under test it was found to have a core loss of 63.6 watts, a quarter load efficiency of 90 per cent., a full load efficiency of 94.8 per cent., a regulation of 3 per cent., and a no load current of .087 ampere.

Suppose we estimate the economy of transformers of this type just as we did those of the type previously considered. The 40 transformers, working on the same schedule, would waste 4,014 kilowatt hours more power than they should under the specifications advertised. At 2 cents per kilowatt hour the total money loss would be $80 per year, or over 6.5 per cent. of the cost price of $1,200.

Many engineers may claim that the cost of checking up the performance of the transformers would more than eat up the saving effected by the small margin that these results represent, and in many cases under the present organization this would doubtless be true, but if a well-advised stand was taken by the central station managers for mutual protection the result would be markedly beneficial.

A percentage of the transformer output of each of the manufacturing firms could, for instance, be tested in some one place, where a record of the individual performance of all the transformers submitted for trial could be kept, and not only efficiency, but aging and insulation and temperature trials could be made at a merely nominal expense.

But these examples do not cover the ground. I will cite two others.

In the case of a 15-kilowatt oil insulated transformer, guaranteed to develop a quarter load efficiency of 96 per cent, a full load efficiency of 97.4 per cent. and to have a regulation of 1.77 per cent., the test showed a quarter load efficiency of 94.5 per cent., a full load efficiency of 96.1 per cent., and a regulation of 1.6 per cent. The core loss of this transformer, which operates at 60 cycles, is 186.6 watts, and the specifications under which it was built require that the core loss should be about 150 watts.

It would take seven of these to give an output of 100 kilowatts—and they would cost not less than $115 each. The seven transformers in this case would waste 3,855 kilowatt hours in a year, which represents a financial loss of $77 in one year over and above the loss to be expected. This approximates 10 per cent. of the original cost of the transformers and is an item that cannot be neglected. If, on the other hand, this waste power could be sold at 6 cents per kilowatt hour, it would represent a part of the just return on the investment contemplated when the transformers were purchased, and would mean $221 to the company.

I do not claim that the figures which I present to you cover all the items of expense that enter into the installation of 100 kilowatts—in transformers. They do not, but they do represent a phase of the question that deserves more than passing attention at a time when competition is becoming sharper and sharper.

In what I have so far said I have not touched upon the matter of the aging of the transformer core iron. In cases where it is appreciable it only serves to aggravate the conditions and make the percentage loss greater. In the same way the cost of production and the selling price of the power both enter as important factors, as well as the cost of the transformers. All of these assumptions I have placed low and they should be regarded rather as pertinent examples of the conditions that exist in large plants. The small plants will be affected by influences of this character to a much greater extent.

I do not wish to tire you with figures, but as I believe you will be interested in these comparisons of guaranteed and actual efficiencies, I wish to call your attention to one more case before leaving this matter. Not long ago a manufacturing company requested permission to send a 1-kilowatt transformer to the University laboratories for a special test, as the transformer was of a new type and highly efficient. There was no direct guarantee in this case, but the impression was given that the transformer would develop an efficiency equal to, if not exceeding, the efficiency of any other transformer of like capacity on the market. The results of our tests indicated a core loss of 178 watts, a full load efficiency of 82.6, a quarter load efficiency of 62.4 and an all-day efficiency of only 54.5 per cent.

There are probably to-day a goodly number of the so called "highly efficient" transformers eating up the profits of various of our lighting companies throughout the country, simply for the reason that in many cases business managers of electric light and power plants are not sufficiently alive to the importance of looking after the efficiency of the apparatus forming their equipments just as closely as they look after and check up every item of operating expense and maintenance that is necessitated by the exigencies of the service.

The use of transformers such as the one just referred to would be pitiable. It is fortunate that they do not grow to large proportions, but nevertheless they have a telling effect wherever they fall.

As regards the aging of the modern transformer irons, I hold rather a conservative opinion at the present time. A great deal has undoubtedly been accomplished within the last few years in the way of improvement in this respect, and the modern transformers that are supplied to us for testing show a wonderful gain in efficiency, due both to the lower initial core losses and to the diminished per cent. of these core losses with the aging of the iron.

The general opinion seems to prevail at present to the effect that aging is due directly to the reversal of the direction of the flow of the magnetic flux in, rather than to long continued heating of, the iron

forming the cores of transformers, and this opinion is also expressed in much of the printed matter that has come into my hands.

In a lecture delivered by Prof. Fleming he said: "It was also discovered, some time back, by Mr. W. Mordey that prolonged slow heating of iron to only 60° C. or 90° C. has a marked effect on the hysteretic constant, and the result is often to increase this constant two or three times. The effect varies with the annealing of the iron, and in many cases the iron, which shows the least hysteretic constant at starting experiences the largest percentage increase of it on prolonged heating. This effect is called the magnetic aging of the iron. Owing to the enormous use of iron for transformer purposes this aging had now become a very important matter.

"The electrician lays no very great stress on the mechanical qualities, such as tensile strength, elasticity and so on, but he requires high permeability, small hysteretic constant and small aging; and the iron and steel manufacturer has been able of late years to meet these new requests by producing steel of the necessary quality. Iron and steel can now be produced with a maximum permeability of 4,000 C. G. S. units, a hysteretic loss of about .15 watt pound per 100 cycles per 2,500 flux density, and of non-aging quality. I do not mean to imply that all these qualities can be equally combined in the same sample, but that the iron or steel can be varied to suit the demand.

"Steel can be produced with a higher permeability than wrought iron for large magnetic forces, and with a superior non-aging quality."

The fact seems to be well established that non-aging transformer iron is a commercial possibility, but the fact remains to be demonstrated practically that material of the necessary quality can be obtained in sufficiently large quantities to supply the demands that are being made upon the manufactories.

Failure in this regard is not the fault of the builders of the transformers, and I have reason to know that there are cases in which disquiet prevails in the minds of managers as to whether or not they are getting what they are paying for. I know that the general claim is made that iron with an "inappreciable aging effect" is used, and I do not wish to go on record as claiming that it is not used, but what I do wish to point out is that there are transformers being placed on the market to-day that do not contain non-aging iron. From a large transformer company I have received notice that "at the present time we have not non-aging iron which will fulfill our specifications of core loss; that which we have on hand will give a core loss of from 20 to 25 per cent. greater than the amount stated in our specifications." At the present time therefore it is needful to make just as careful tests for aging as for efficiency or for insulation, in spite of the fact that the former take a longer time and are therefore relatively more expensive to make.

During the last three months six transformers of different types have been subjected to most carefully conducted aging tests in our laboratories. The completed report on these tests has come to me in the last few days and I can give you a resume of the results.

The core losses of transformers A and B were high to begin with, the first being 72 watts and the latter 83 watts. The per cent. increase in the core loss of these two transformers does not, however, seem to be as great as the per cent. increase in the core losses of transformers C and D that are of more recent manufacture, and that showed initial core losses of 31.5 and 37 watts respectively.

Transformers B and D are of 1.5 kilowatt capacity and transformers A and C of 2.5 kilowatt capacity. An increase of from 5 to 10 per cent. is shown in all the transformers.

To get an idea of what this means, suppose we consider the effect upon the economy of the 2.5 kilowatt transformers, considered in the second case discussed above of a 10 per cent. increase in the core loss. It will add $1.11 per year to the cost of operating each transformer at 2 cents per kilowatt hour, or $44.40 for the total number.

This represents an additional gain of 3.7 per cent. per year on the investment in three months, or a possible percentage loss on the investment of 14.8 per cent., after the first year, on the supposition of a uniform increase in the core loss.

These figures are not startling in any way; they are too small for that, but they are matters of fact to be taken into consideration when making investments. The opinions that I am voicing regarding the aging of modern transformer irons are conservative, as I believe the transformers built to-day will show a marked improvement upon the performance of transformers built even as late as one year ago. As far as the aging tests that we have made go to throw light upon the subject, I am inclined to believe that the aging problem has as yet not been solved, as none of the transformers tested have met the requirements of the specifications under which they were submitted, and some have fallen very far short of it. All of the transformers tested were new except transformer A, which at the time these tests began had a core loss already increased to 13 per cent. above its initial value. Transformer A was built about two years ago.

The aging of transformer iron does not increase at a constant rate with the time. The rate of increase diminishes as the service continues, but the increase may go on indefinitely. Until the use of non aging iron becomes more generally possible than at present, it is probable that it will pay to replace the majority of the transformers placed on market by new ones every few years.

It is our present intention to inaugurate next fall a series of one year aging tests under continuous full load conditions of a representative number of transformers that will be built during the present summer by the manufacturing companies who are interested in having these points thoroughly ventilated, and I trust to be able to publish a record of fine performance in this respect at the time of the completion of the tests.

The correct insulation of transformers is another important point that should be considered by the central station manager. Like many of the problems with which we have to deal in the effort to make the transformer a commercial success, this one seems to be subject to a wide variety of opinion. The oil insulation of transformers has deservedly come into great favor, and where care is taken in the selection of the oils used and in the proper design of the transformer case, high protection is secured. Oil insulation under all circumstances does not, however, secure to the purchaser the protection which he feels he is paying for. The claims that are usually made for the superiority of oil insulation, to wit, that it serves to preserve the insulation from oxidation, reinforces the resistance of the insulation to puncture, reinsulates punctures after the passage of the discharge and facilitates the diffusion of the energy liberated as heat in the core and the coils, can in general be readily substantiated.

My experience, however, is that these statements must be regarded as having only a relative bearing upon the subject. Under certain circumstances the insulating value of an oil will be very materially impaired. We are told that transformers will last indefinitely when insulated with oil, whereas without oil the insulation will be so deteriorated after five or ten years that the transformers should be replaced, and it may therefore be a matter of surprise that the insulating qualities of the oil itself are ever seriously diminished. As a matter of fact experiment shows that the insulating properties of the oil commonly used in transformers are increased as their temperatures are raised up to about 110° C., and that if allowed to cool they will not lose their augmented power of resisting a disruptive discharge. This much might be said in favor of oil insulation, in view of this two or threefold gain in insulating power, were it not for the fact that a continued heating of the oil for any considerable length of time changes the oil to such an extent that on being cooled its breakdown value will be only about one-fifth of its original value. And therefore an oil insulated transformer that will stand an insulation test of 10,000 volts when new, may break down under a pressure of 2,000 volts after having been in continuous service for a considerable time. Conditions such as will produce a result of this character are not likely to occur in the case of modern transformers, as the increase in the temperature of even the poorest transformers rarely exceeds 70° C. I have, however, met with cases in which excessive heating has resulted when the transformers were kept continuously in service, and I have also in mind a case in which a good modern transformer was so situated above a tin roof and in a position where it was protected from any breeze that might be stirring, that, when the sun played upon it, its temperature reached perfectly distressing values.

What I have said will serve as a hint of how not to handle a transformer, and the importance of selecting proper places for the location of transformers.

If you will look carefully into the matter you will find that not all of the burnouts are due to faulty construction on the part of the manufacturer. It is my experience that the contractor has been in fault in a fair proportion of the cases in which the transformer and service installation has suffered.

For all commercial purposes the best oils will be found to give thoroughly satisfactory results and retain their insulating properties unimpaired so long as the maximum temperature of the oil does not exceed 60° or 70° C. In making a station test of a transformer, if the rise in the temperature of the windings, as measured by the increase of resistance method, does not exceed 50° C. after a 10 hours' run at full load, the transformer may be passed as satisfactory in this respect.

In connection with oil insulation it must be remembered that its efficiency as an insulating medium is impaired by discharges in the oil.

One of the foremost claims made in behalf of oil insulation is that it will flow in and fill up a rupture in the insulation of the coils. Every electric discharge that takes place through the oil, however, disintegrates and breaks up the normal structure of the oil, and causes carbon and other conducting compounds to form. These will rapidly multiply if the discharges are at all frequent, and will destroy the insulating properties of the oil.

As a case in point, and I presume you may know of other similar instances, I want to call your attention to a very good example of what good practice vs. bad practice will accomplish.

There is a city in the West in which the conditions under which electricity is supplied for incandescent lighting are somewhat unusual. There are two companies interested in the business, and both employ the alternating current converter system of distribution. The plant that is operated by the older company was installed about six years ago and its equipment has grown slowly from year to year as business expanded. Its development has followed the waves of evolution modifying electric lighting practice within this period with a lag factor approximating 90°. The plant has some strictly modern machinery, but much of the line equipment is old. A number of its transformers have been burnt out on account of defective insulation, some have been burnt out by lightning and some have shown their efficiency by getting so hot when switched in on an all day schedule, under light load, that the "oil used to insulate them boiled up and over and ran down the outsides of the cases."

It is needless to say that in the latter type of transformer the hysteretic losses were considerable; the transformers were, however, manufactured by a firm of high commercial standing.

The lines of the old company are not protected by lightning arresters, except where they enter the station, and the secondaries are not grounded.

The new company has been in operation two years and its plant is thoroughly up to date and highly efficient. Oil-insulated transformers of from 80 to 200 lights' capacity are used, and are kept in continuous service. The transformers are of modern design and stand an insulation test of 7,000 volts, without oil. The lines of the new company run over those of the old company and are protected about every 1,500 feet by lightning arresters. None of the secondaries of these transformers are, however, grounded, and magnetic shields are not used. The new company has never experienced any trouble from burnouts of any kind, although its lines are very much exposed. In a very violent electric storm which occured some time since, in which the service of the old company suffered in consequence of transformer burnouts, the service of the new company was not interfered with in any way, although lightning struck its lines several times.

There has been a great deal of interest expressed recently in the effort to formulate a definite set of specifications covering the construction and insulation of transformers, with the end in view of decreasing the fire hazard and supplying the necessary protection from loss of life and property to both the producer and consumer of electrical energy.

In a letter that I have lately received from a gentleman who is much interested in the success of this project, he says that after corresponding with a number of makers, engineers and lighting companies to obtain suggestions as to the remedies for the troubles arising from crosses, lightning, insulation, break-downs, etc., the results were very unsatisfactory, as there seemed to be a vast difference of opinion.

I have read a great many articles for and against the use of earthing devices, grounded shields and grounded secondaries, but I am yet to be convinced that the prominent American practice of high insulation resistance to a disruptive discharge and a plentiful use of well-grounded short air-gap lightning arresters, does not give a sufficiently good protection.

As I have already remarked, the number of modern transformers that are reported as burning out is relatively very small. By far the greater portion of the troubles arise from crosses between the high and the low potential circuits, and in such cases the loss must be attributed to faulty installation and not to any imperfection in the transformer.

An oil insulated transformer for use on 2,500-volt primary circuits, or less, having a maximum temperature at full load not exceeding 65° C. and designed to stand an insulation test without oil of 750 volts for five minutes, and a prolonged test of 10,000 volts with oil, will be in slight danger from lightning discharges if protected within a distance of 500 feet by a properly installed lightning arrester.

A transformer should also be able to stand a double primary potential test for 5 minutes, and the insulation test should be made between the coils and between each coil and the core.

In the case of transformers to be used exclusively on very high voltage circuits these considerations do not apply, nor should this paper be considered as dealing with this class of alternating apparatus, which has come to form a department by itself.

In considering the economy of transformers, the problem before us is not so much a discussion of their efficiency as a converter of electrical energy, as it is a discussion of this efficiency in connection with the numerous extraneous causes that tend to make the transformer a menace to life and property.

To my mind a great deal would be gained if an understanding could be brought about between the makers and purchasers of transformers that would result in a uniform practice in the several departments of transformer design. The manufacturers would work to better advantage by having definite specifications to work to, and the way would be open for a bonus or forfeit in equitable proportion to an excess of or shortage in the economy of the product. The fad at present tends toward over-protection. It is bad practice to run to extremes in any department of engineering, and too much protection may turn out to be just as costly as too little.

On the Yttric Earths Contained in the Monazite Sands.

By M. O. BOUDOUARD, in *Comptes Rendus.*

In a previous paper (*Comptes Rendus*, cxxii., p. 697), in collaboration with the late M. Schutzenberger, I predicted the possible existence of a new earth precipitable by oxalic acid, not giving an insoluble double sulphate with the alkaline sulphates, and of which the atomic weight should be about 102. This was only a first indication, and it is the results I have since obtained that I now have the honor of presenting to the Academy.[1]

A. I mixed the oxides of which the atomic weights of the corresponding metals were 102.2, 102.45, 102.6, 103 and 102.4, and dissolved them in nitric acid. The nitrate was transformed into sulphate, and, after the addition of sulphate of potassium to remove the earths of the cerium group (*Comptes Rendus*, cxxvi., p. 900), the yttric earths were precipitated with ammonia. The hydrates after being washed, to get rid of all traces of alkali, were dissolved in nitric acid. This nitrate was submitted to fractional fusion at 325°:

Sub-nitrate.....	103.0 atomic weight.
Mother liquors	97.7 "

The oxide 103, transformed into nitrate and submitted to a fresh fusion, gave:

Sub-nitrate.....	109.5 atomic weight.
Mother liquors.....	100.6 "

Finally, the mother liquor 97.7, by an analogous fractionation, gave:

Sub-nitrate.....	98.7 atomic weight
Mother liquors.....	97.5 "

B. In this second series I mixed different oxides, the atomic weights of the corresponding metals varying from 95.1 to 99.1 (the greater part gave figures varying from 98.2 to 99.1). I then applied the above mentioned treatment to this mixture, and the yttria earths thus obtained were dissolved in nitric acid. The nitrate was submitted to a fractional fusion at 325°, which gave:

Sub-nitrate, No. 1	103.6 atomic weight.
Sub-nitrate, No. 2	97.5 "
Mother liquors.....	96.7 "

The sub-nitrate No. 1, submitted to a fresh fusion, was divided into two portions:

Sub-nitrate, No. 1	108.5 atomic weight.
Mother liquors	98.5 "

C. I then mixed all the oxides of which the automic weights of the corresponding metals varied from 96 to 112. I collected about 70 grms. of this mixture.

After having eliminated the earths of the ceric group by sulphate of potassium, the unprecipitated oxides were dissolved in nitric acid, and hyposulphite of soda was added to the neutral solution of the nitrate. A precipitate was formed; the reaction is quicker when the solution is warmed than in the cold. The precipitate is collected on a filter and washed. In the clear solution the excess of alkaline hyposulphite is removed, and the unprecipitated earths are brought to the state of oxalates. I thus obtained 45 grms. of earths precipitable by hyposulphite of sodium, and 25 grms. of earths which were not so precipitable. I am now studying these two fractions. This property of hyposulphite of soda seems to me to be so much the more interesting as Fresenius, in

1. Academy of Sciences, France.

his "Traité de Chemie Qualitative" (eighth French edition, p. 134), states that the salts of yttrium are not precipitated by hyposulphite of soda.

The yttric oxides examined in the above three series give almost colorless solutions, of which the absorption spectrum is very feeble; it is characterized by the following wave lengths:

657—663	Very faint	(erbium.)
643—639	"	(holmium.)
537	"	(holmium.)
524—522	Faint	(erbium.)

The solutions examined under a thickness of 4 c.m. were saturated; the earth was in the state of sulphate.

If we now compare the results obtained in the first two series, we observe that the minimum atomic weight reached is 96.7, and that the other numbers obtained are in the neighborhood of 97.5. We are far from the atomic weight of yttrium, which is 89.5.

M. Drossbach (*Berichte*, vol. xxix., No. 15, p. 2452; *Moniteur Quesneville*, May, 1897, p. 351), in examining a monazite, announced the probable existence of an earth with an atomic weight of about 100. He is of the opinion that there is therein a new series of earths in the proportion about 20 to 30 per cent.

MM. Urbain and Budichowski (*Comptes Rendus*, cxxiv., p. 618, and cxxvi., p. 835), in fractionating the acetyl-acetonates of the yttric earths, and M. Urbain in examining the ethylsulphates, reached a low limit of fractions which could no longer be split up—a limit which did not go below 95.

These results—later than those of M. Schutzenberger and myself, who predicted them—now confirm what we anticipated.

Ought we, from this collection of facts, to conclude that the presence of a new earth is proved? or have we only to deal with a mixture of yttria and of an earth with a higher atomic weight? According to this hypothesis, it is necessary to admit of a mixture of more than 90 parts of yttria to 10 of erbia (average atomic weight 97.6), or of ytterbia (average atomic weight 98.2), or of terbia (average atomic weight 95.7.)

Nordenskiold (*Comptes Rendus*, ciii., p. 795), in 1886, obtained an oxide with a constant atomic weight of 107, which he called *oxide of gadolinium;* he thought that he was authorized to admit that oxide of gadolinium, although not an oxide of a simple body, but a mixture of three isomorphous bodies, even when obtained from minerals altogether different and found in localities very far apart from one another, possesses a constant atomic weight. Is the oxide with the atomic weight 97 an oxide of the same kind?

On the other hand, it is permissible to suppose the existence of a new element very near yttrium? This hypothesis is not untenable; it is sufficient to recall the discussion between M. Lecoq de Boisbaudran and Sir William Crookes (*Comptes Rendus*, cviii., p. 165) on the nature of yttrium.

Sir William Crookes called *yttria* a mixture of earths endowed with varied fluorescence, and of which the elements formed a family of bodies very close together,—species of yttriums, with atomic weights oscillating round about 89; in any case these different yttrias gave the same spark spectra.

M. Lecoq de Boisbaudran called yttria the non-fluorescent earth (which we may suppose to be simple or complex) producing the well-known spectrum, and of which the atomic weight is 89.

To sum up, the process of fractionations (sulphates, nitrates, acetylacetonates, ethyl-sulphates) gives a low limit beyond which no further splitting up takes place; this limit is round about 96.

Is this limit only apparent? This is a point which researches I am now actually engaged on may perhaps elucidate.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, July 10th, 1898.

The June Meetings.—Temperature of Gas Measurement.—Acetylene.—Sale of Residuals.—Tar for Roadways.

The meetings of the Institution of Gas Engineers, and of the Gas Institute, have been held, and the anticipations expressed in discussing the preliminary notices last month have been fully realized, the whole passing off smoothly and harmoniously. Taking the Institution first, the report of a special Committee on Standards of Light, and the Temperature of Gas Measurement, was a very important item. The question of a standard of light, which was also the subject of a paper, is a matter of academic rather than of practical interest. There is a book published, called "Every man his own lawyer," by the general public, and "Every fool his own client," by the legal fraternity; and following the example thus indicated, every gas consumer is to a certain extent his own photometrist, and forms his own opinion about the quality of the gas with which he is supplied, with very little respect for the report of the Official Examiner. So the all round manager of a medium sized gas undertaking, as a rule, prefers to direct his attention to questions having a more direct bearing on the problem of how to turn out a good article at the lowest possible cost, rather than to niceties involving fractions per cent. in measuring, and which are as likely to lead up to a definite general agreement, as the discussions of certain learned theologians. But the effect of temperature in gas measurement is a matter of general interest to all concerned in the supply or the consumption of gas. Hitherto it has been usual to assume that, for any place within the boundaries of England, the act of correcting the indications of the gas works station meter to 60° F., was a kind of double barrelled adjustment that not only reduced the readings to one level basis, available for comparison with the results obtainable at other places, but also secured a close approximation to the mean temperature under which the gas was measured at the consumers' meters, and thus practically eliminated any errors due to differences of temperature from the "unaccounted for" gas account. Evidently the basis for comparison may be 60°, 65°, 70° or anything else, assuming that all complex mixtures of gases, or gases and vapors, observe the same regularity in the matter of expansion and contraction according to temperature, that is experienced with hydrogen and other simple gases. This I have sometimes been inclined to doubt, on account of results obtained when corrections covering a margin of 40° or 50° have to be made. To any inclined to verify this, I would recommend a simple laboratory experiment as follows: On the coldest day available in winter, put out all stoves, etc., and open windows so as to reduce the temperature to the outside degree, say 30° F. Make a laboratory test of a sample of coal under these conditions. Having completed it and measured the gas, close up all windows, etc., and drive the warming apparatus to the fullest possible extent, so as to get something like a summer temperature, say 80°. Make a second test under these conditions and compare the volume obtained in the first test with that of the second, after making the usual corrections for temperature. According to theory they should be equal. However this may be, it is obvious that the less the extent of the correction the better. But as regards the idea that 60° is a fair mean selling temperature, the researches of the Committee, which include a lengthy series of observations taken on the premises of consumers, upon all sorts and conditions of meters and of consumption, show that the selling temperature is more like 50°, while the mean atmospheric temperature is several degrees below 60°. But daily readings of the thermometer do not fairly represent the case, unless an equal quantity of gas is taken each day, which is not at all likely to be the case. If the readings of the thermometer, instead of being based upon equal intervals of time, could be based upon even quantities of gas, being read at every 10,000 cubic feet, or other convenient unit, the mean would be considerably lower, and it would be the actual average selling temperature. This cannot be secured by time readings, under the usual circumstances of a December consumption about three times that of a July. Space does not admit of further reference to the proceedings of the Institution, but before leaving this subject I must make a note of the highly favorable opinions expressed about the inclined retort system by those who have adopted it.

The most attractive feature in the Gas Institute Proceedings was the lecture by Prof. Vivian B. Lewes on the modern developments of acetylene. At a time when extravagant claims are put forth on behalf of this gas, to the effect that, light for light, it is as cheap as coal gas at current prices, the figures quoted in the course of the lecture are worthy of careful attention. The Professor takes the actual present cost of calcium carbide at £16 per ton free on rail at the factory, to which must be added the cost of carriage to the place where it is to be used, and adds that the prospects of a reduction in this figure, by the aid of improvements in working, etc., are "not very hopeful." Taking a production of 11,000 cubic feet per ton, and assuming that the residual lime is of sufficient value to counterbalance the cost of labor, wear and tear of generator and other incidental expenses, the cost of the gas would come out somewhere between 30s. and 40s. per 1,000 cubic feet, or about twelve times the cost of ordinary gas. Although acetylene is valued at 240 candles, the Professor states that in practice it is only 175, or 35 candles per cubic foot. Evidently the advocates of acetylene suffer from the same mental aberation that is a common affliction amongst electrical engineers, and which takes the form of supposing that the only appli-

ance available for gas consumers who use it as a source of artificial light, is a rusty and badly gone iron burner. At the present time most gas engineers can exhibit in their show rooms more than one appliance for obtaining a duty equal to three-fourths that of acetylene. This brings the relative value as 4 to 3, and the relative cost as 9 to 1. But there are out-of-the-way places where a supply of coal gas is not available, and purposes for which a very high quality gas offers special advantages. So acetylene is being used to some extent, although it cannot get within reasonable limits of competition with coal gas. Referring to the use of compressed gas for railway carriages, Prof. Lewes showed that a mixture of 20 per cent. of acetylene with oil gas, was more profitable and convenient for use than oil gas alone. In this case the costs of compression and transit depend on the bulk of the gas and not on its quality, and, therefore, the richer the gas the less will be the cost of handling it. In concluding, he dealt with the properties of acetylene as an enricher of non-luminous or of poor gases. It was known to be practically valueless as applied to blue water gas, but this defect was greatly ameliorated by the presence of methane in the diluent. He described a process of the water gas type, in which vapors of petroleum were sprayed in with the steam, with the result that in place of the usual half and half of hydrogen and carbonic oxide, it yielded a gas composed of 45 per cent. hydrogen, 15 per cent. carbonic oxide and 30 per cent. methane. This gas possessed a very low illuminating value, but the addition of 5 per cent. of acetylene would bring it up to 18 or 20 candle power. In places where oil was cheap a mixture of this sort might prove to be the gas of the future, and a useful substitute for ordinary coal gas. As in the case of the "Institution," I must postpone a few remarks on some of the papers read to a future occasion.

In view of the attention that has been directed to the sale of tar and ammoniacal liquor, a few particulars of the attempts made in England in the way of securing better prices will probably be acceptable. As regards tar, the figure at present offered by distillers is so small as scarcely to cover the costs of conveyance for distances over 50 miles, and my own practice has been to sell preferably to makers of tar pavement, rather than to distillers. I have also mixed a fair quantity of tar pavement on the works, and laid the same on customers' premises at an inclusive charge. A fair business should be available in this line in any advancing town where there is a fair amount of building going on in the suburbs. But the worst of this class of trade is that it is only a summer trade, and unless the tar well is large enough to store the winter's make, there is the difficulty of finding an outlet for tar in January or February. I notice that a combination of 16 neighboring gas companies has been promoted in the Midlands, under the title of the "Derby and District Residual Products Committee," and is inviting tenders for 1,300 tons of tar and a similar quantity of liquor. Then there is the Sulphate of Ammonia Committee, which has just issued the report of its first year's working. This covers the details of an expenditure of £2,684, raised by a levy of 6d. per ton of sulphate sold by the members, and which appears to represent over one-half of the total normal production. £300 have gone for management, £547 for advertising, and the remainder for pamphlets, prizes, etc. The Committee have decided on a similar levy for this year, to enable them to continue the work. I am a believer in combined action to the extent of regarding it as a useful auxiliary and support to the personal efforts that should be exerted by every maker of tar or liquor. But it is a mistake to suppose that the Association is a sort of penny-in-the-slot automatic machine, and that all responsibility is shelved and compounded for by the payment of a subscription. "Put in your money and the figure will work" may be true as regards ingeniously constructed toys, but is not so in the case of any trade association.

The attention of all who desire to find a new outlet for tar may be directed to a paper read at the recent meeting of the Association of Municipal and County Engineers, held at Edinburgh, by Mr. Campbell, the City Surveyor of Canterbury, on the use of tarred macadam for roadways. It is stated to be inexpensive, non-absorbent, smooth and noiseless, clean in itself and easily kept clean. Yet although tarred gravel or limestone footwalks are to be met with in every town, tarred macadam has found very little favor. The reason of this is stated to be that although the mixing and laying appear very simple matters, the whole proceeding bristles with delicate detail if it is to be a success. The stone must be heated before the tar is applied, not merely to dry it and drive out moisture, but to enable it to take the tar properly. This it will do if just so warm that it can be held comfortably in the hand. If too hot, the cohesive power of the tar will be destroyed, and if too cold the tar will go on too thickly and be liable to soften under a hot sun. The 2-inch stone will be disintegrated to some extent by the roasting, and when ready to be mixed with the tar should be sifted through 1-inch and ½-inch gauges, thus yielding three sizes of material—viz., over 1-inch for the bottom, over ½-inch for the intermediate, and under ½-inch for the top-dressing. These should be laid 3 to 4 inches thick of the bottom, about ¾-inch of the intermediate, and the top-dressing as thin as possible, merely enough to fill up interstices. A dressing of fine granite or limestone siftings is added, and traffic at once allowed. Each layer is rolled separately with a 10-ton steam roller, and the work should only be done in the summer, and preferably in hot, sunny weather. In preparing the road, the old surface is removed to a depth of 8 inches, and re-made with a 4-inch thickness of hard, dry, broken stone, rolled smooth and finished to the camber of the road. The mixture must be quite fresh when laid and all traffic must be stopped during the work. Ordinary gas works tar must be quite freed from water and light oils before being used by boiling for three or four hours, the exact time being varied according to the quality of the tar. The total cost will be about 9s. per cubic yard.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Superintendent Dole, of the Bangor (Me.) Gas Company, has about completed the placing of a new main, through Second street to Union street. This branch will enable him to distribute gas throughout the town with much greater satisfaction to the consumers and to the Company, than under the single works' outlet heretofore depended upon.

Mr. George B. Edgar, Secretary and Treasurer of the Coshocton (Ohio) Light, Fuel and Power Company, has been quite active this season in directing many improvements on the Company's generating plant. Important betterments have also been made on the distributing system, quite a stretch of the original leading main having been supplanted by pipe of larger size, the substitution, of course, involving the replacing of all the service pipes along the changed line. The Company's business during the past year has shown that increase which results from a go-ahead management trying its best to fit itself to meet the needs of a rapidly growing district. The Company's annual election resulted in the naming of the following officers: Directors, Houston Hay, John C. Fisher, Geo. A. Hay, Frank E. Pomerene and Geo. B. Edgar; President, Houston Hay; Vice-President, John C. Fisher; Secy. and Treas., Geo. B. Edgar.

The New Amsterdam (N.Y.) Gas Company has authorized the United Gas Improvement Company to construct, at the former's East River station, a set of standard, double-superheater Lowe water gas apparatus, the daily capacity of which installation is put at 4,000,000 cubic feet.

Mr. H. Fisher Eldredge has been elected President of the Portsmouth (N. H.) Gas and Electric Light Company, vice the late Mr. Marcellus Eldredge. The Hon. Calvin Page was named to the Directorate. A dividend of 2 per cent. on the Company's capital is payable on demand.

The Otto gas engines (two in number, of 110-horse power each) recently installed in the works of the Stockton (Cal.) Gas and Electric Company, are replying satisfactorily to every power question that is asked of them.

An application has been made to put the plant and properties of the Menominee (Mich.) Gas Light and Fuel Company in the control of a receiver. The case was considered over a fortnight ago, but we have not been informed as to the decree of the court respecting it.

Mr. Henry B. Leach, Superintendent and "bow anchor" of the Taunton (Mass.) Gas Light Company, seems to be keeping the Taunton gas vessel well abreast of the tide of the day; and our prediction in this regard may not be successfully denied. About mid-July the Company held its annual meeting, and when the votes were counted it was found that the old management had been unanimously elected to succeed itself. The Directors signalized their retention in office by voting to reduce the selling rates in this proportion: Ordinary consumers (those using less than 125,000 cubic feet per quarter, to pay $1.30 per 1,000 cubic feet; extraordinary consumers to be entitled to their supply at $1.20 per 1,000. Mr. Leach is also *considering* plans for the construction of a new wharf, etc. The named rate concession is to date from Oct. 1.

The Saratoga (N. Y.) Gas, Electric Light and Power Company has declared a dividend of 2½ per cent. on its preferred stock, payable today.

THE Delaware County Gas Company, of Chester county, Pa., has moved into its new and well arranged offices, 517 Market street, Chester. General Manager Callanan has provided a goodly stock of gas ranges, etc., which can be inspected at any time during the working days of the week, and also on the evenings of Monday, Friday and Saturday. Mr. Callanan also proposes to encourage the introduction of automatic meters.

THE United Gas Improvement Company has purchased the plot at the corner of Broad and Tasker streets, Philadelphia. It is presumed the intention of the purchaser is to convert the building (it was formerly the residence of Mr. G. H. Smith) now on the plot into a branch office for the better convenience of its customers.

AT the annual meeting of the Waterloo and Seneca Falls (N. Y.) Gas Light Company the following officers were chosen: Directors, R. J. Dobson, P. W. Bailey, Fred. Maier, Jr., Edward Miller and A. W. Massey; President, Fred. Maier, Jr.; Secretary, Treasurer and General Manager, R. J. Dobson.

RUMOR has it that, in the rearrangement of the gas interests of Buffalo, N. Y., Mr. E. H. Jenkins will be appointed General Manager of the succeeding Company.

THE Gas Light Company of the City of New Brunswick, N. J., has contracted with the United Gas Improvement Company to install its modern standard, double superheater Lowe water gas apparatus up to a daily capacity of 400,000 cubic feet. The Company will also add new purifiers and a new station meter, and will change the works over to the relief holder system.

THE Newark (N.J.) *News*, of July 22d said: "The Board of Directors of the Newark Gas Company has ratified the sale of stock held by the Trustees, at the rate and according to the terms agreed upon by the Trustees and the purchasing syndicate last Monday. The formal transfer of the 'trusteed' stock will not be made prior to November 15, and after that date it is expected the new owners will assume control. As already stated, $25,000 of the purchase price has been paid, $250,000 will be paid August 1st, and the balance on or before the date fixed for the close of the transaction. It appears that only the 'trusteed' stock will be paid for at the rate of $310 per share, for that will give the new owners complete control of the Company, with power to increase its capital stock, and do anything else they may feel disposed to do with the property. Some of the Directors say the holders of stock which was not 'trusteed,' will have an opportunity to sell at $310, if inclined to do so. From another source it was learned that those stockholders have been offered cash at the rate of $310 for half their stock, but no more. It is also hinted that the syndicate is desirous of paying for the 'trusteed' stock on a basis of half cash and half bonds of a new issue. If the syndicate is able to secure the stock on that basis its actual cash outlay for the control of the property will be only $1,550,000, and it is intimated in financial circles that the syndicate may experience difficulty in securing even that amount of cash."

THE plant of the Palmyra (N. Y.) Gas Light Company has been overhauled. The management proposes to increase the output on fuel account, if liberal terms can bring about such a result in Palmyra.

AT the annual meeting of the Greenfield (Mass.) Gas Company semi-annual dividends of $1.50 per share on the preferred and $1 per share for the common stocks, were declared. The annual reports showed a satisfactory business, and that considerable mainlaying had been done. The officers elected were: Directors, J. D. Safford, Dana Malone, W. N. Washburn, W. A. Forbes, and F. A. Pond; President, J. D. Safford; Treasurer, A. R. Willard; Clerk, William S. Allen.

A CORRESPONDENT in Denver, Col., writing under date of July 21st, forwards the following: "The annual meeting of the Colorado Springs Gas and Electric Company was held yesterday morning. The annual reports showed a very satisfactory condition of affairs. The Company has done much in the way of mainlaying during the last few months to keep up with the demands for gas in the newer sections of the city. The present Company took possession of the works about four years ago, and since that time it has been busily engaged in improving its works and extending the main systems. The extensions on latter account have been in all directions in Colorado Springs and also into Colorado City. The business in Colorado City advanced so rapidly that the Company was obliged to lay a new main to that place (it was through Washington avenue), which line was completed a few weeks ago. During May, June and July the Company finished the laying of something over 3 miles of mains. The use of gas for cooking purposes has found great favor in Colorado Springs, and the Welsbach burner is likewise a mighty agent for spreading the use of gas for lighting. The Directors (all residents of Colorado Springs) elected were: Irving Howbert, J. F. Humphrey, F. H. Morley, J. A. Hayes, W. P. Bonbright, R. J. Bolles and W. P. Copeland.—S."

THE United Gas Improvement Company has been authorized by the Pittsfield (Mass.) Coal Gas Company to build for it a second set of 6 ft. standard, double superheater Lowe water gas apparatus. The extension to the plant shows how rapidly the Pittsfield Company's business is increasing.

THE Spartanburg (S. C.) Gas, Electric Light and Street Railway Company has been incorporated to take over the gas, electric light and street railroad properties of Spartanburg, and to operate the same on joint account. The incorporators are Messrs. Elliot Norton, William E. Lown, George G. Day and Albert Leszynsky, all of New York city. The concern is capitalized in $200,000.

THE special election held last month in Washington, Iowa, for the purpose of determining whether or not a franchise should be granted to the projectors of a Company for the manufacture and distribution of gas in that place, resulted in a good majority in favor of the proposition.

MR. WILDER F. LAWRENCE has assumed the Superintendency of the Trenton (N. J.) Gas Light Company. The Company has secured new and suitable office quarters in a building on South Warren street, below State street.

AT the annual meeting of the Attleboro (Mass.) Gas Light Company the officers chosen were: Directors, William J. Luther, James E. Blake, Homer M. Daggett, Jr., Geo. A. Dean, Albert W. Sturdy and John R. Bronson; President, George A. Dean; Vice-President, Everett S. Capron; Secretary and Treasurer, A. W. Sturdy.

UNDER the clever management of Mr. A. M. Voorhis the trade of the Nyack (N. Y.) Gas Light and Fuel Company steadily increases. Many extensions to the Company's plant are underway, not the least important of which is a new holder, rated to retain about 100,000 cubic feet. The Kerr-Murray Manufacturing Company is erecting the vessel, and the understanding is that it will be completed about September 1st. The Nyack Company had to secure a site in which to place the holder, and Manager Voorhis is still congratulating himself over the successful negotiations that enabled him to obtain the needed land from the executors of the Kirkpatrick estate.

AT the annual meeting of the Easthampton (Mass.) Gas Company, a dividend of 3 per cent. was declared. Mr. H. L. Clark was elected Clerk, and Mr. G. L. Manchester was elected Treasurer.

THE executive management chosen last month by the Directors of the Consolidated Gas Company, of Baltimore, Md., is as follows: President, John W. Hall; Vice-President, James A. Gary; Secretary, N. W. Meginnis; Treasurer, Joseph W. Clarke.

THE proprietors of the Kingston (N. Y.) Electric Company, who also operate the local gas plant, have announced a reduction of 10 cents per 1,000 cubic feet in the gas rate.

C. W., H. E. and T. H. Asbury, A. C. Harmer, Jr., N. H. Rand and G. U. G. Holman have applied to the Governor of Pennsylvania for a charter for the "Oak Lane Gas Company," which concern proposes to "manufacture gas for light, heat and power purposes" in Montgomery county, Pa.

AT the annual meeting of the Galion (Ohio) Gas Light Company the Directors chosen were: James S. Kuhn, D. B. Ludwick, J. H. Purdy, John M. Andrews and Chas. Glenn.

A DIVIDEND of 3 per cent. on the preferred stock of the Consolidated Gas Company, of Pittsburg, Pa., is payable to-day.

The Market for Gas Securities.

There was rather more done last week in city gas shares than for a fortnight or more. Prices, too, were on the advancing scale, Consolidated having sold at 200½. To-day (Friday) the opening quotation was 197½ to 199. It is not at all unlikely that in this month important developments in the instance of better prices for city gas shares will be recorded. Standard shares were in better demand, and the inquiry resulted in slightly higher quotations. The common is 139 to 141, and the preferred is 154 to 158.

Brooklyn Union is steady and so is Baltimore Consolidated. Bay State crossed 4 this week, and quite a bit of business was done in it for Philadelphia account. Peoples, of Chicago, is very close to par, and careful viewers of the market believe that it is about at its full value just now. Buffalo gas securities are dull and low.

Gas Stocks.

Quotations by Frederic B. Cochran & Co., Brokers and Dealers in Gas Stocks.
20 and 22 Broad Street, New York City.
Aug. 1.

☞ All communications will receive particular attention ☜ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$36,230,000	100	198	198½
Cental Union, Bonds, 5's	3,000,000	1,000	99½	100
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	330	337
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	31¼	31¾
Preferred	10,000,000	100	76½	77
Bonds, 5's	11,000,000	1,000	102	103¾
Northern	150,000	50	..	
" Bonds	150,000	1,000	..	
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	106	109
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	139	141
Preferred	5,000,000	100	153	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	121	124
" " Bonds (5's)	15 000,000	1,000	115	115½
Bay State	50,000,000	50	4	4⅛
" Income Bonds	2,000,000	1,000	..	75
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	92
2d " " "	3,000,000	1,000	70	..
Buffalo City Gas Co.	7,000,000	100	28¾	29¾
" " Bonds, 5's	7,000,000	1,000	95¾	96
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7.650,000	1,000	104	104¼
Columbus	1,069,000	.	80	91
1st Mortgage	1,085,000	..	101	103½
Consumers. Jersey City	2,000,000	100	75	80
" Bonds	600,000	1,000	100	103¾
Cincinnati G. & C. Co.	8,500,000	100	202¼	202½
Consumers, Toronto	1,000,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	64	64¼
Mortgage, 6's	3,000,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit	4,000,000		58	58½
" Con. Bonds	4,312,000	..	94½	96
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	88	91
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	78	88
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	51	51⅛
Preferred	2,500,000	100	92	93
Bonds	9,034,400	1,000	105	105½
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	52	53
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	99⅛	99¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	85¾	86
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	2,500,000	25	17	18
Bonds	1,000 000	..	94	97
Washington, D. C	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	85½	86
Bonds, 5's	3,556,000	.	101¾	102½
Wilmington, Del.	550,000	50	200	

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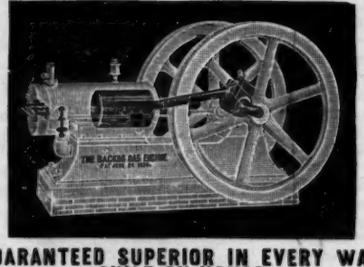

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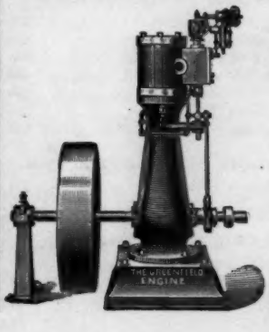

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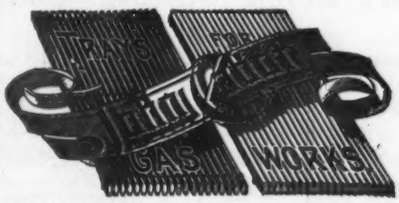

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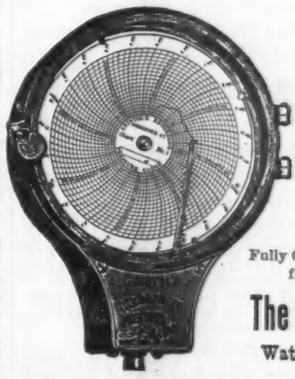

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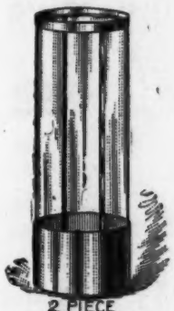

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No Air Shutter, therefore no Smoked Mantles. Hot Air taken from Chimney. Impossible to snap back. "VICTOR" MANTLES are the strongest and most durable on the Market.
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Gas Distribution Without Leakage Loss.

THE PANTACLINAL SYSTEM.

This system includes: Pantaclinal Mains, which are gas tight when laid and remain gas tight during their life in the ground. Also

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To correct the evils incident to rigidity in lines already laid. To repair breaks in mains so that they will not break again. To permit the use, without future disadvantage from leaks or breaks, of stocks of hub and spigot mains on hand or ordered. To permit the relaying, as Pantaclinal lines, of hub and spigot lines now unduly troublesome and expensive to maintain, owing to heavy leakage and liability to fracture. To flexibly couple wrought iron pipes, and correct the enormous leakage which attends their use in gas distribution when laid with rigid couplings. To correct causes of leakage at service taps.

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This is the *original* coal-consuming Furnace for Retort Benches. Burns either Coal or Coke. Full and Half-Depth Regenerative Furnaces for Benches of 6's, 7's, 8's or 9's erected complete.

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A Cement of great value for patching retorts, putting on mouth-pieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

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In Casks, 400 to 800 pounds, at 5 cents per pound.
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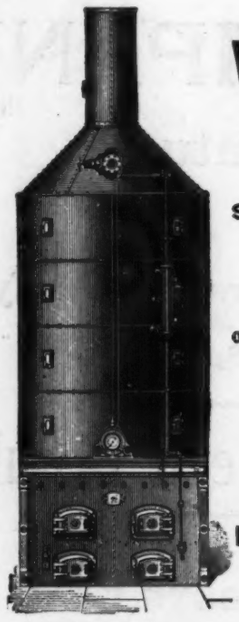

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For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

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For Cutting Cast, Wrought Iron, Gas & Water Pipes.

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MORE DIRECT IN ACTION. FEWER PARTS.
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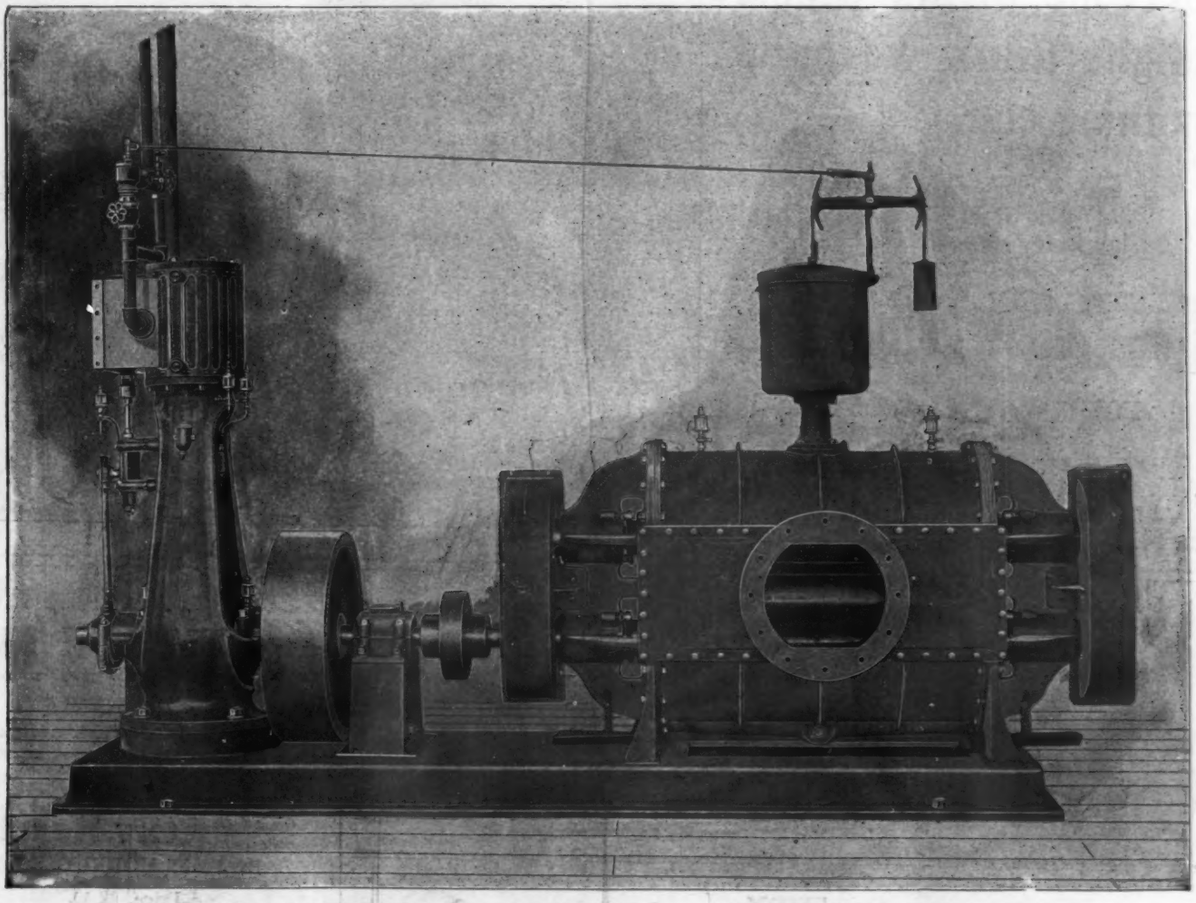

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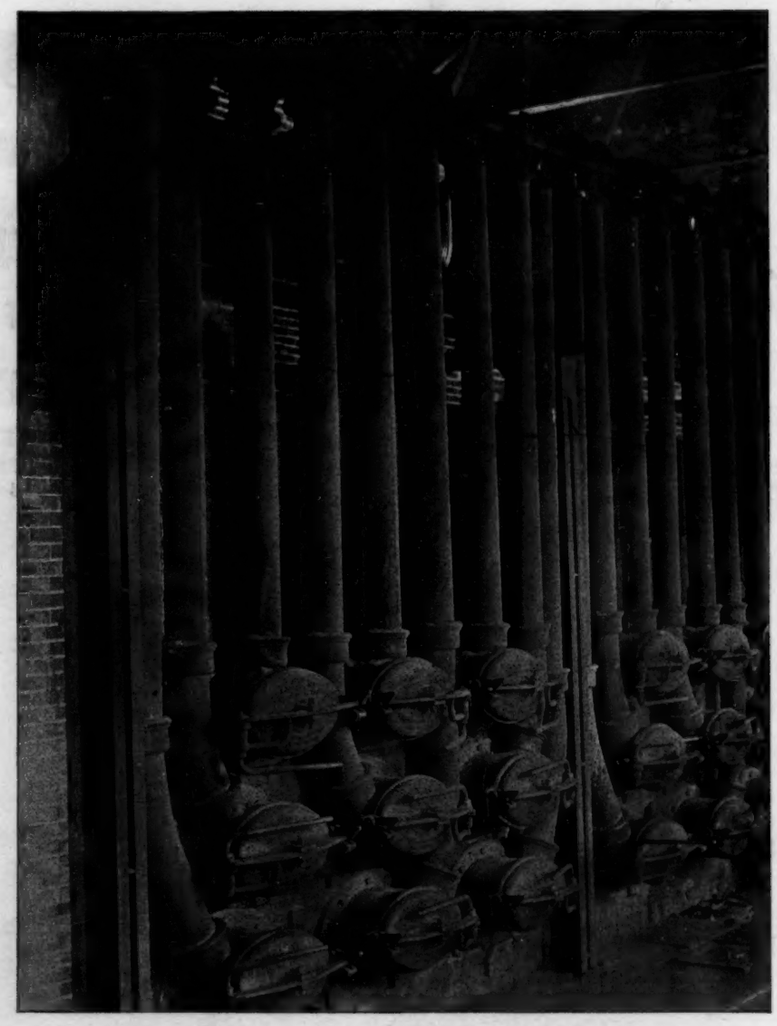

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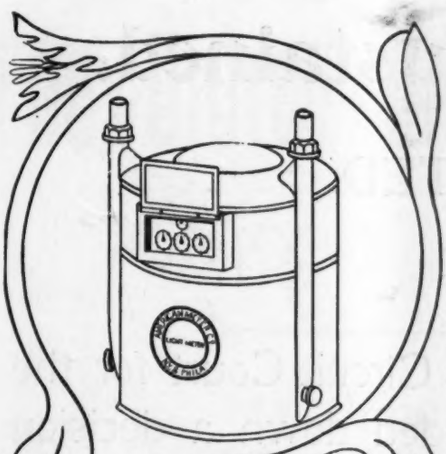

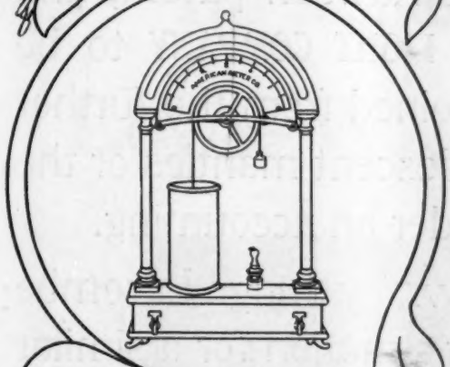

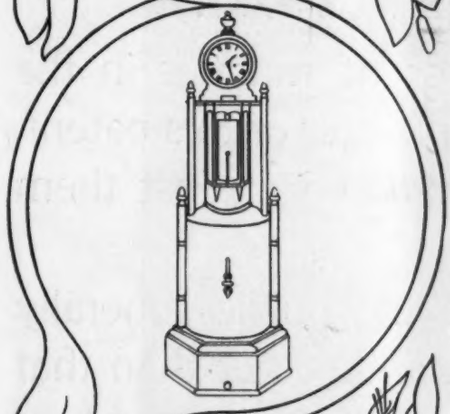

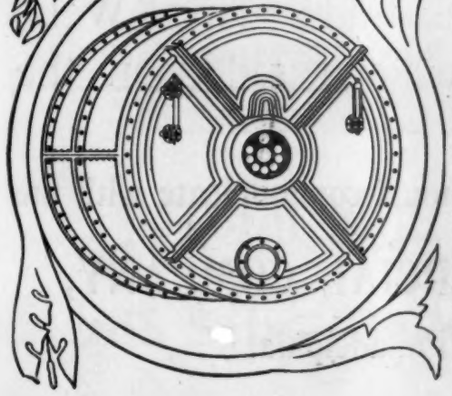

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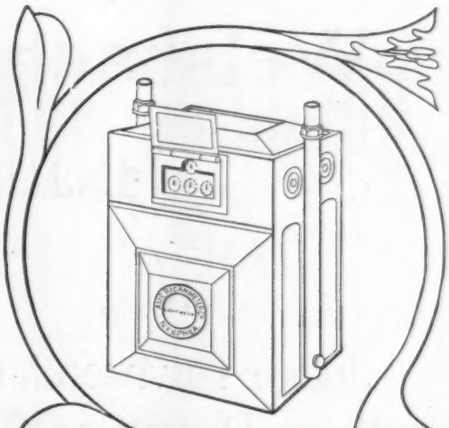
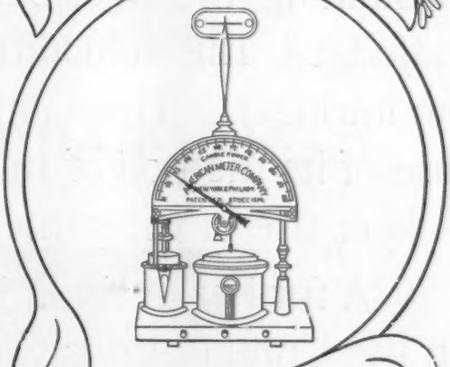
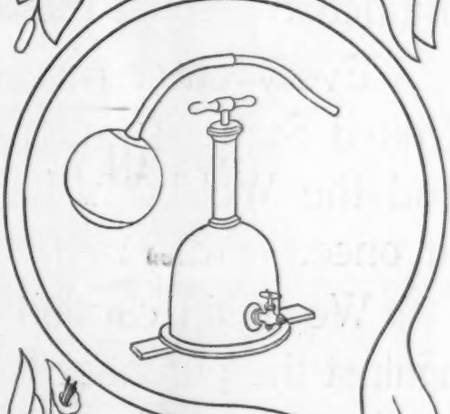
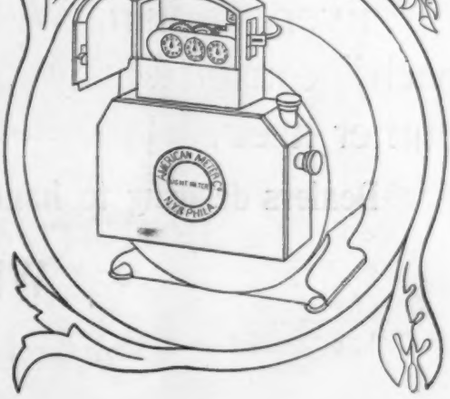








PUBLIC LIGHTING TABLE.

AUGUST, 1898.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	No L. FM	No L.	7.10	3.30
Tue.	2	No L.	No L.	7.10	3.30
Wed.	3	7.40 PM	9.00 PM	7.10	3.30
Thu.	4	7.40	9.20	7.10	3.30
Fri.	5	7.40	9.50	7.10	3.30
Sat.	6	7.40	10.20	7.10	3.45
Sun.	7	7.30	10.50	7.10	3.45
Mon.	8	7.30 LQ	11.20	7.10	3.45
Tue.	9	7.30	12.00	7.10	3.45
Wed.	10	7.30	12.40 AM	7.10	3.45
Thu.	11	7.30	1.30	7.10	3.45
Fri.	12	7.30	2.20	7.10	3.45
Sat.	13	7.30	3.20	6.55	4.00
Sun.	14	7.20	4.10	6.55	4.00
Mon.	15	7.20	4.10	6.55	4.00
Tue.	16	7.20	4.10	6.55	4.00
Wed.	17	7.20 NM	4.10	6.55	4.00
Thu.	18	7.20	4.10	6.55	4.00
Fri.	19	7.20	4.10	6.55	4.00
Sat.	20	7.20	4.10	6.45	4.10
Sun.	21	7.20	4.20	6.45	4.10
Mon.	22	8.00	4.20	6.45	4.10
Tue.	23	8.40	4.20	6.45	4.10
Wed.	24	9.30 FQ	4.20	6.45	4.10
Thu.	25	10.20	4.20	6.45	4.10
Fri.	26	11.30	4.20	6.45	4.10
Sat.	27	12.40 AM	4.20	6.30	4.20
Sun.	28	2.00	4.30	6.30	4.20
Mon.	29	3.20	4.30	6.30	4.20
Tue.	30	No L.	No L.	6.30	4.20
Wed.	31	No L FM	No L.	6.30	4.20

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

Welsbach Patent Sustained.

INJUNCTION GRANTED.

Judge Townsend, in the United States Circuit Court for the Southern District of New York, has handed down a decision sustaining the Welsbach Light Company's Rawson patent, and adjudged **THE SUNLIGHT INCANDESCENT GAS LIGHT COMPANY** to be an infringer. This Company has been enjoined from the further use of its method of manufacture of incandescent mantles or the sale or use of the same, and ordered to render an accounting.

A further decision has been handed down by Judge Lacombe in the United States Circuit Court, granting a motion for a similar injunction against **THE REX INCANDESCENT LIGHT COMPANY.**

Every other manufacturer of incandescent mantles in the United States is under these decisions an infringer of this patent, and the Welsbach Light Company will proceed against them at once.

We again caution gas companies and the public generally against the purchase of any incandescent mantle other than that made and sold by the Welsbach Light Company or its agents.

Every genuine Welsbach lamp has the trade mark "Welsbach" conspicuously printed upon the package and upon the burner itself.

Dealers desiring to handle the genuine article should communicate with the

WELSBACH COMMERCIAL COMPANY,

Drexel Building, Philadelphia.

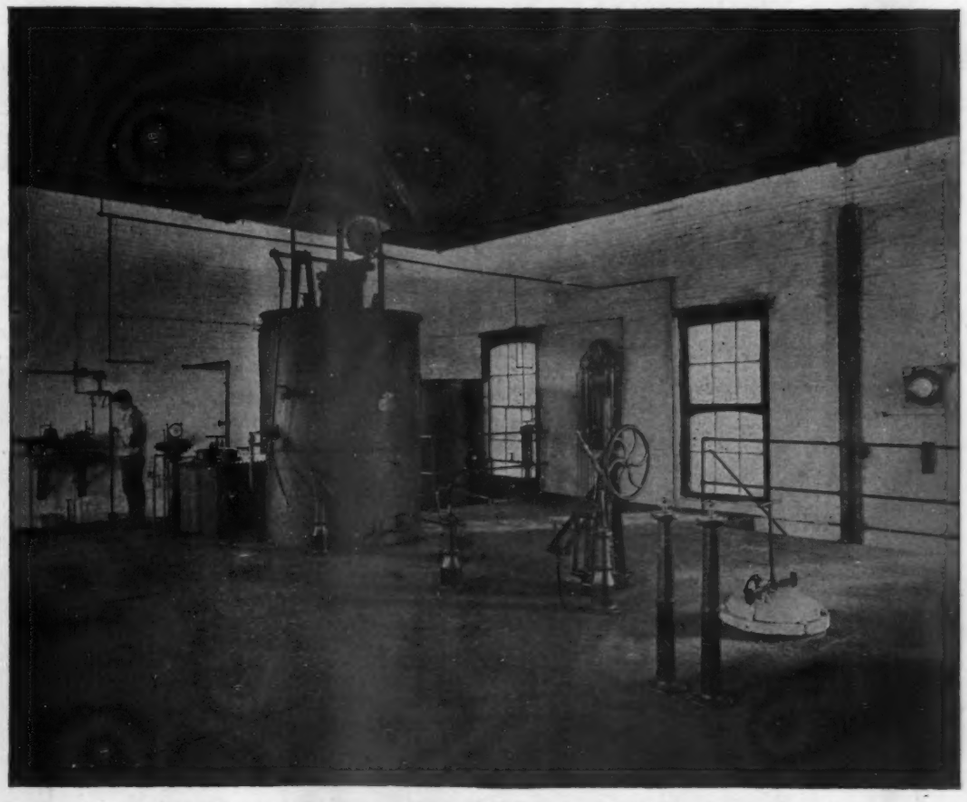
The United Gas Improvement Company,

DREXEL BUILDING, PHILA., PA.

The Standard Junior,

The Standard Double Superheater,

LOWE WATER GAS APPARATUS.



Total Built and under Construction,

288 Sets—Daily Capacity, 185,425,000 Cu. Ft.

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GAS PROPERTIES EXAMINED AND VALUED.
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THE NEW IMPROVED AND PATENTED STREET LIGHT BURNER.

STYLE No. 81.

STYLE No. 97.

Our PATENTED "STREET LIGHT APPLIANCES" have made WELSBACH STREET LIGHTING a complete success.

By the UNIFORM DISTRIBUTION of light on scientific principles a greater area can be lighted by our system and more economically than in any other way.

Where there are no gas mains already laid, we can furnish an equally good light by our **SELF-GENERATING NAPHTHA WELSBACH BURNER,** enabling Gas Companies to furnish a uniform light in all localities.

Lists of Cities and Towns in which we are now lighting under contract will be furnished upon application.

CORRESPONDENCE SOLICITED FROM GAS COMPANIES AND OTHERS INTERESTED IN MUNICIPAL LIGHTING.

NATIONAL GAS AND WATER CO.,

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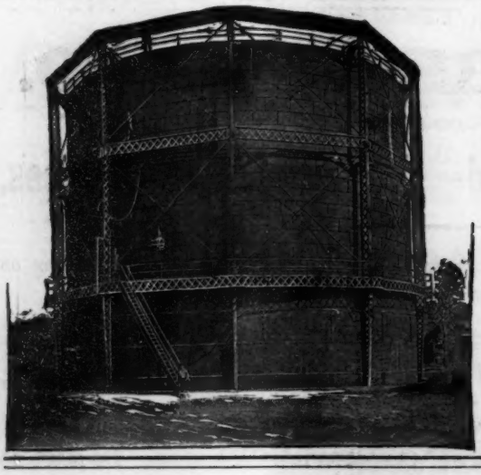

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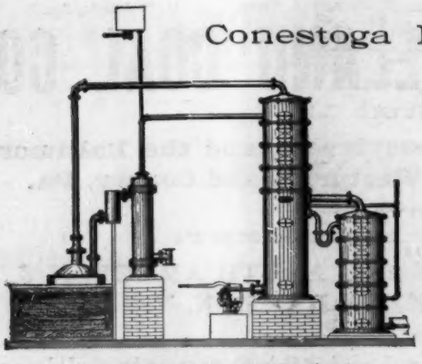

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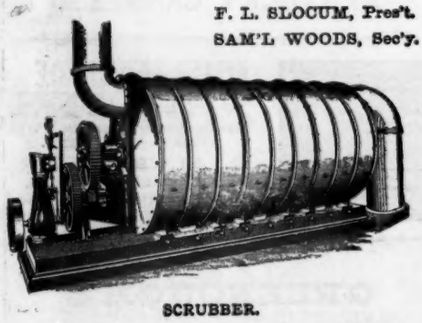

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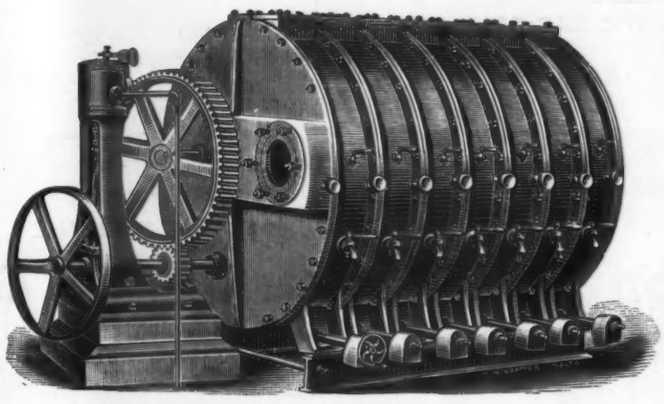

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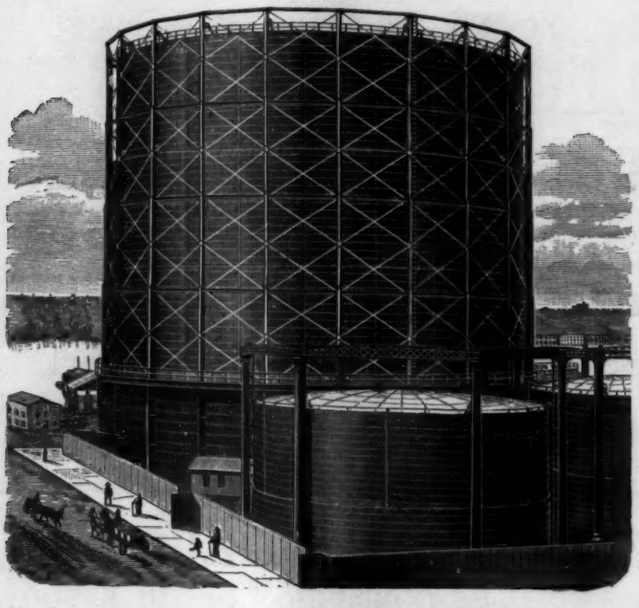

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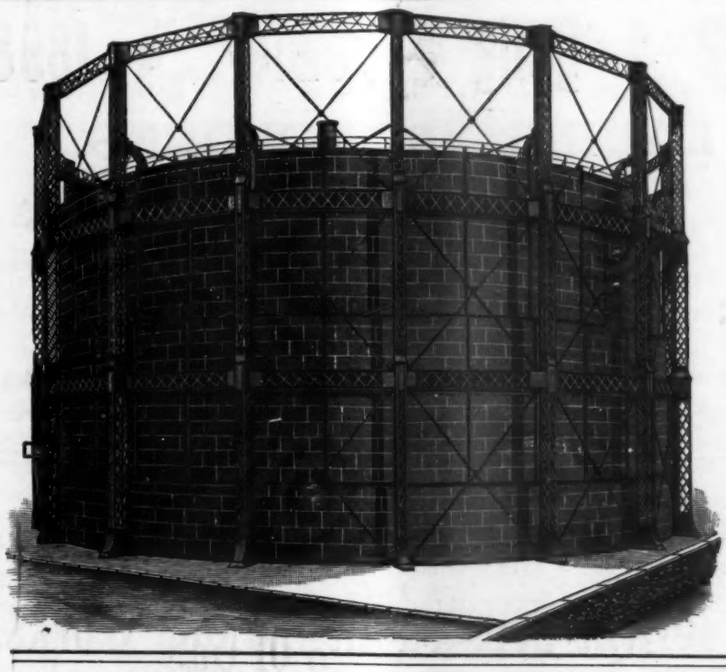

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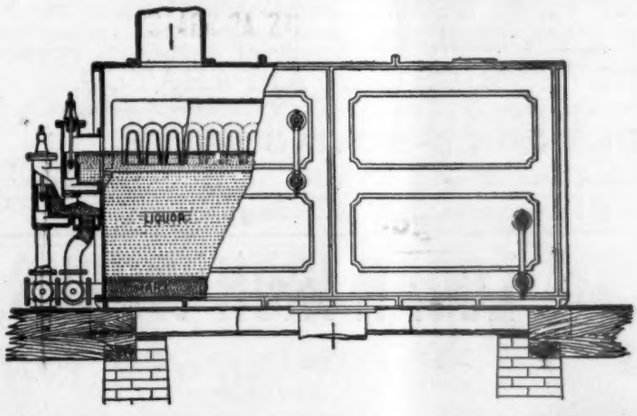

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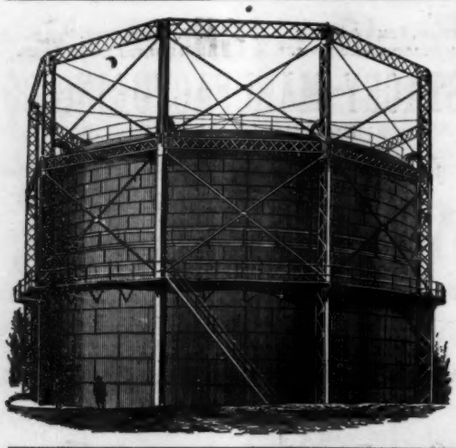

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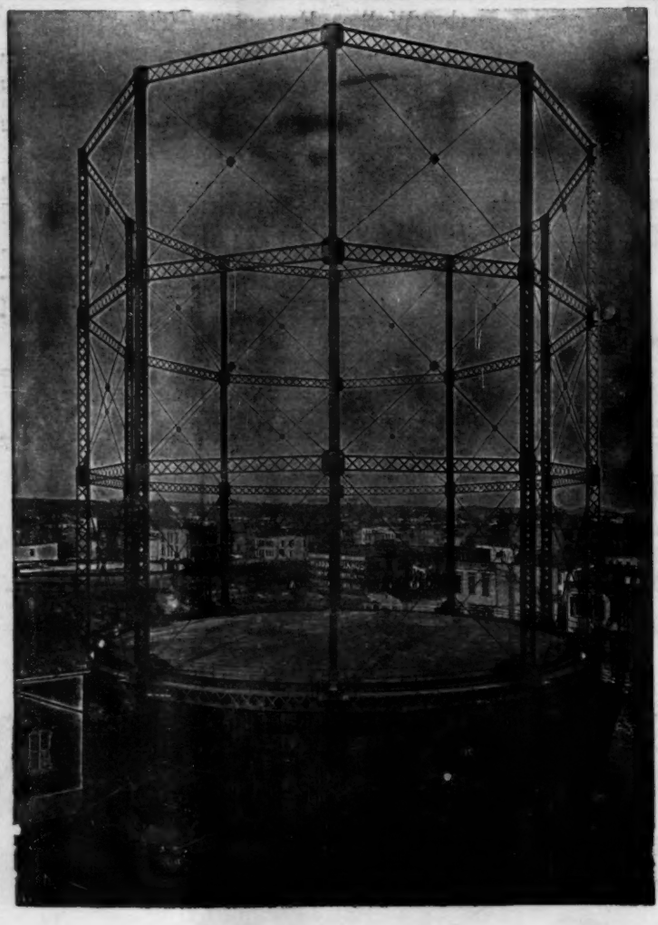

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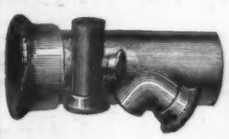

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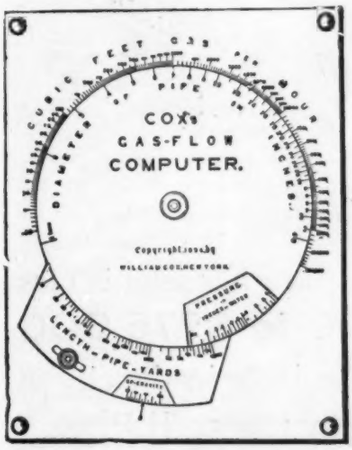

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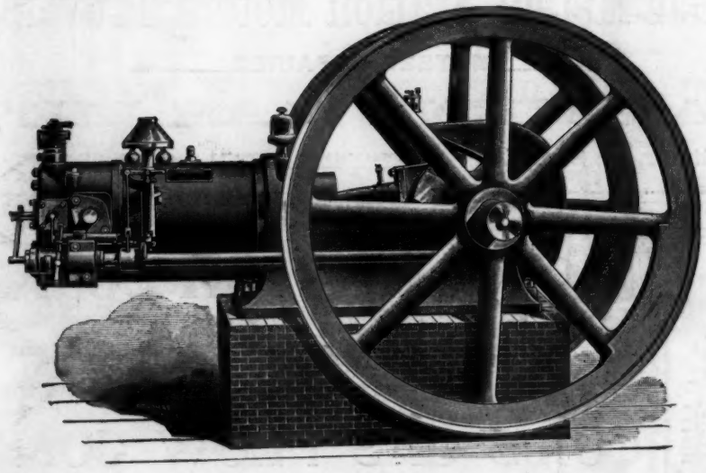

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